FIG. 1

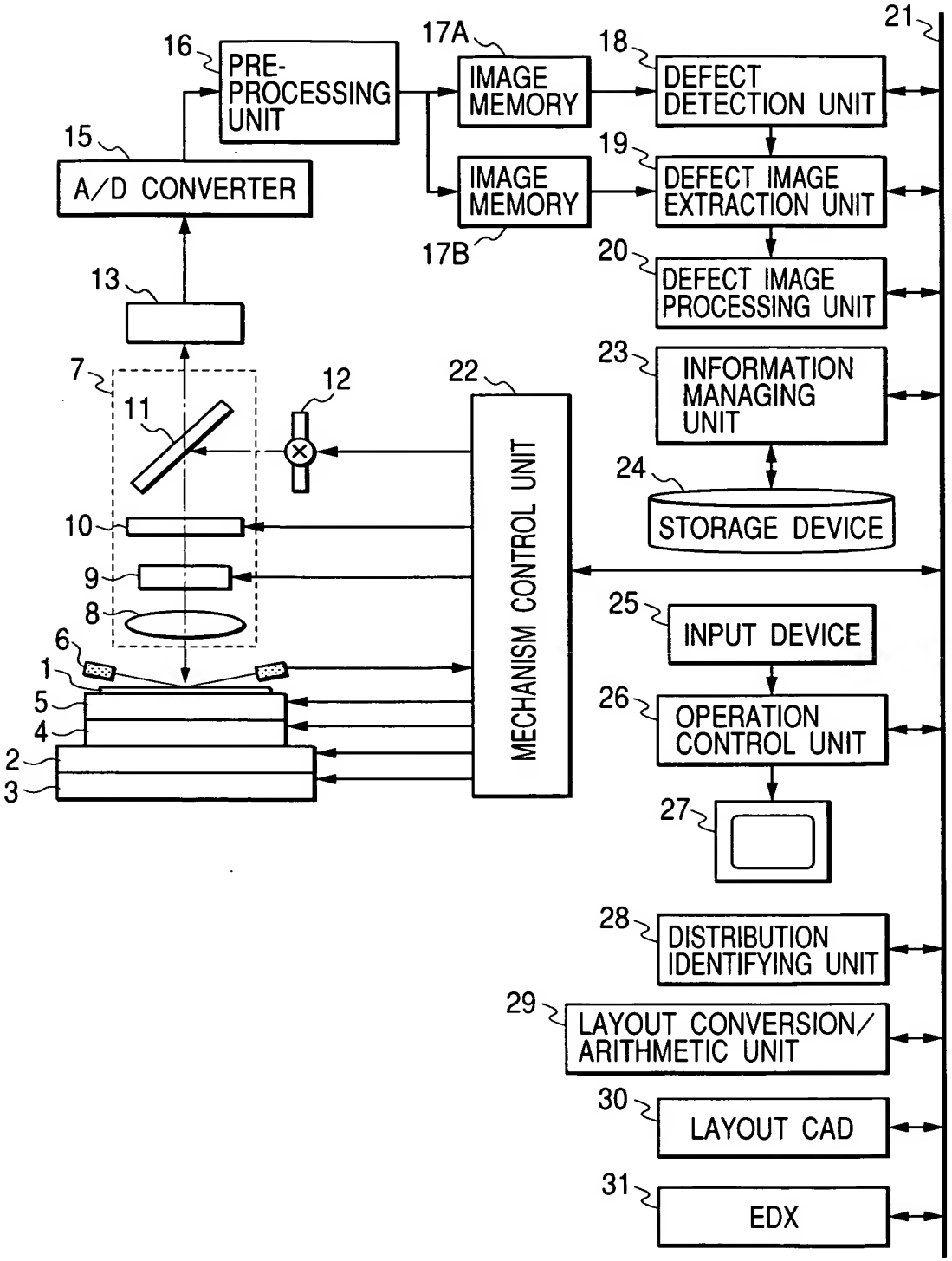

16
PRE-PROCESSING UNIT
17A
IMAGE MEMORY
18
DEFECT DETECTION UNIT
21
15
A/D CONVERTER
19
IMAGE MEMORY
DEFECT IMAGE EXTRACTION UNIT
17B
20
DEFECT IMAGE PROCESSING UNIT
13
23
INFORMATION MANAGING UNIT
7
12
22
11
24
STORAGE DEVICE
10
9
MECHANISM CONTROL UNIT
8
25
INPUT DEVICE
6
1
26
OPERATION CONTROL UNIT
5
4
27
2
3
28
DISTRIBUTION IDENTIFYING UNIT
29
LAYOUT CONVERSION/ ARITHMETIC UNIT
30
LAYOUT CAD
31
EDX

FIG. 2

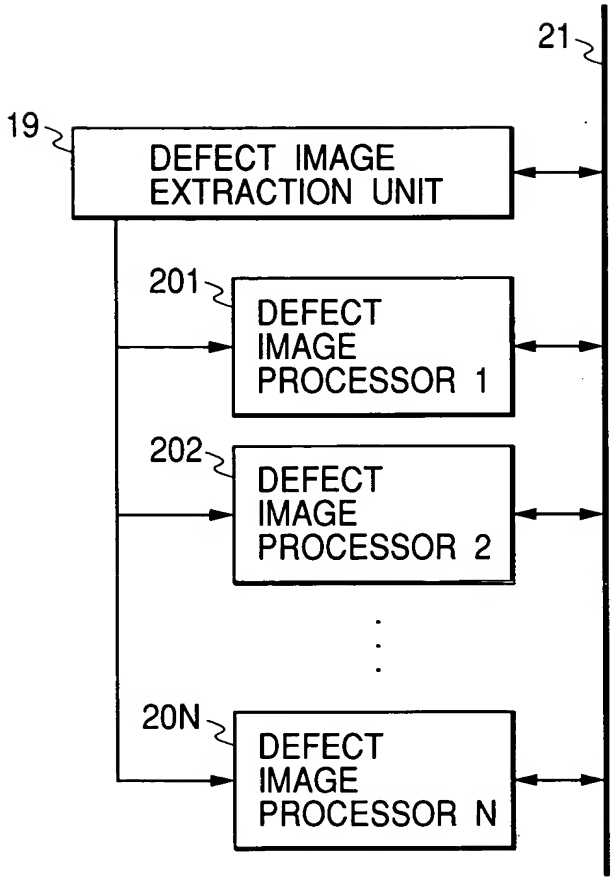

21
19
DEFECT IMAGE EXTRACTION UNIT
201
DEFECT IMAGE PROCESSOR 1
202
DEFECT IMAGE PROCESSOR 2
20N
DEFECT IMAGE PROCESSOR N

FIG. 3

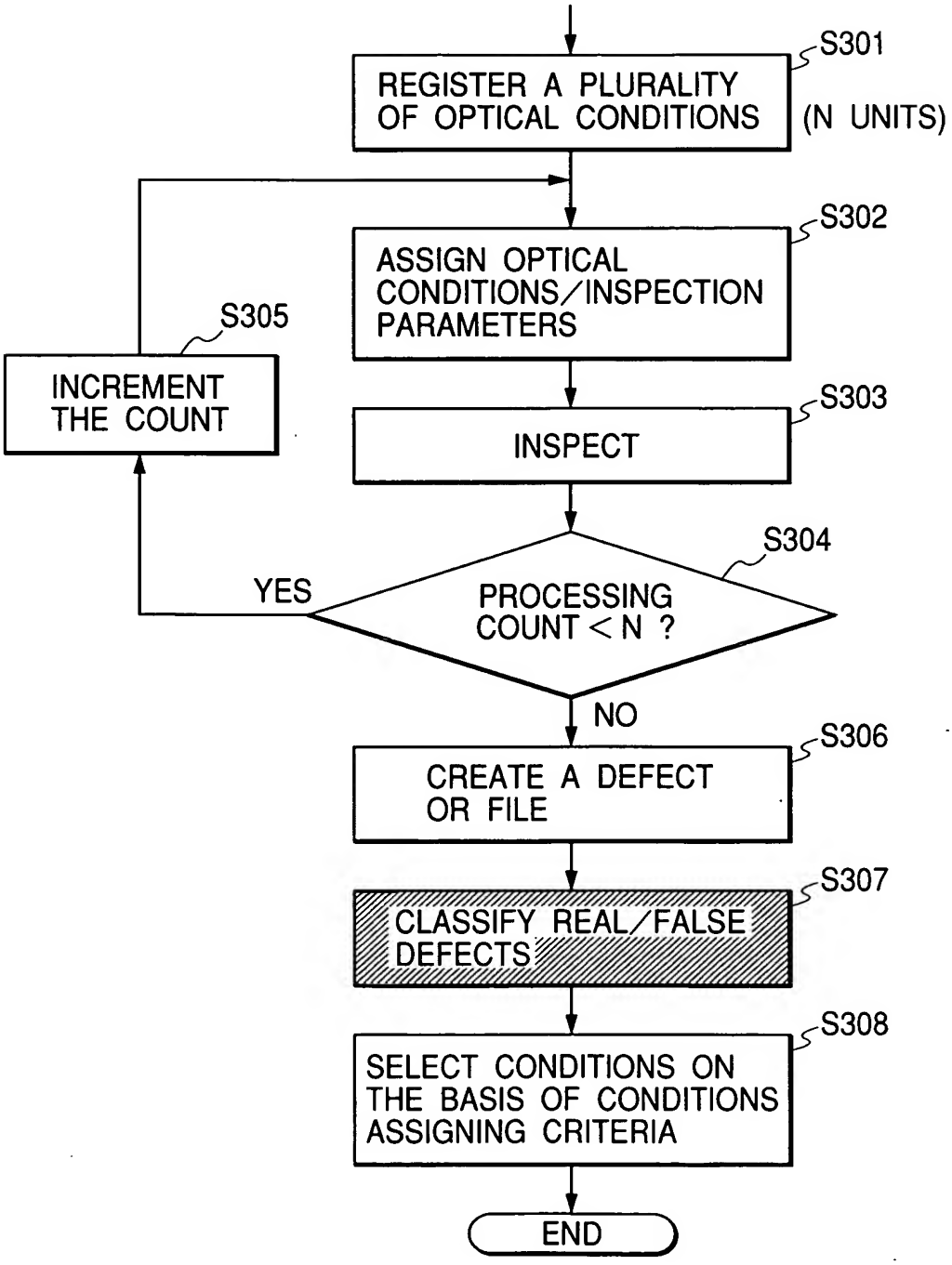

S301
REGISTER A PLURALITY OF OPTICAL CONDITIONS
(N UNITS)
S302
ASSIGN OPTICAL CONDITIONS/INSPECTION PARAMETERS
S303
INSPECT
S304
PROCESSING COUNT < N ?
YES
S305
INCREMENT THE COUNT
NO
S306
CREATE A DEFECT OR FILE
S307
CLASSIFY REAL/FALSE DEFECTS
S308
SELECT CONDITIONS ON THE BASIS OF CONDITIONS ASSIGNING CRITERIA
END

FIG. 4A

EXAMPLE SHOWING THE RELATIONSHIP OF DEFECT OR FILE

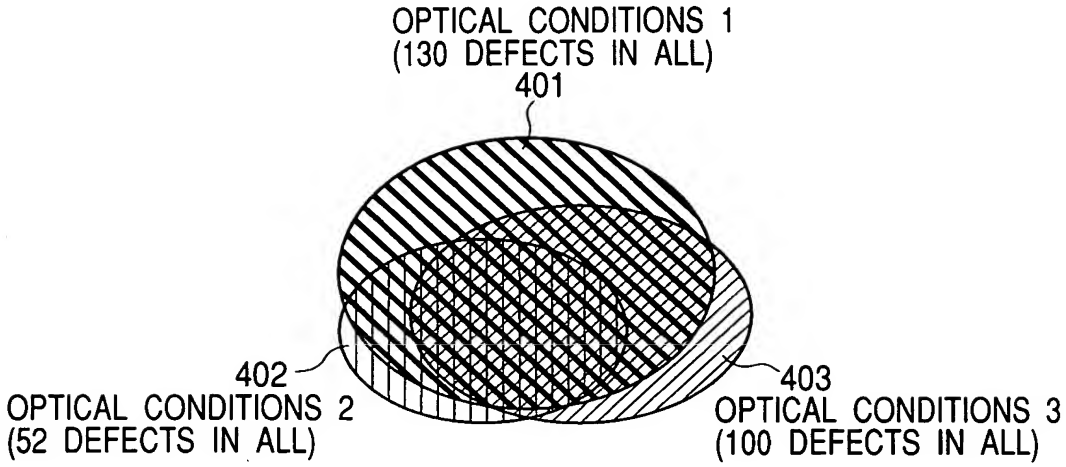


FIG. 4B

EXAMPLE SHOWING A BREAKDOWN OF DEFECTS FOR EACH SET OF CONDITIONS

OPTICAL CONDITIONS	REAL DEFECTS (α)	MISSES (β)	FALSE DEFECTS (γ)	ERRORS ($\beta + \gamma$)
1	100	20	30	50
2	50	70	2	72
3	90	30	10	40
TOTAL (OR)	120	-	-	-

404 405 406 407 408 409 410

FIG. 4C

EXAMPLE SHOWING A CRITERIA ASSIGNMENT WINDOW FOR SELECTION OF CONDITIONS

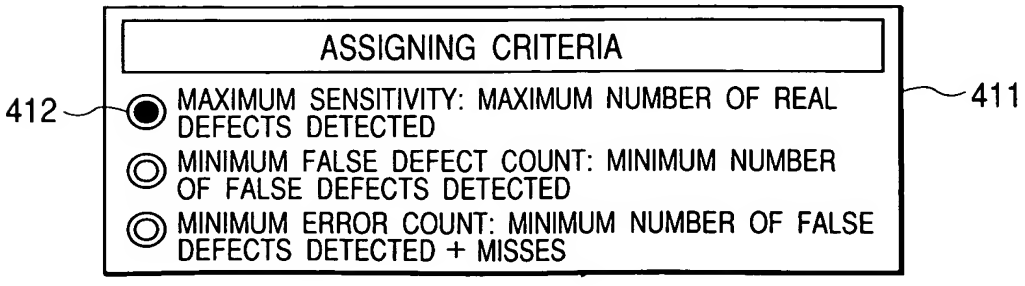


FIG. 5

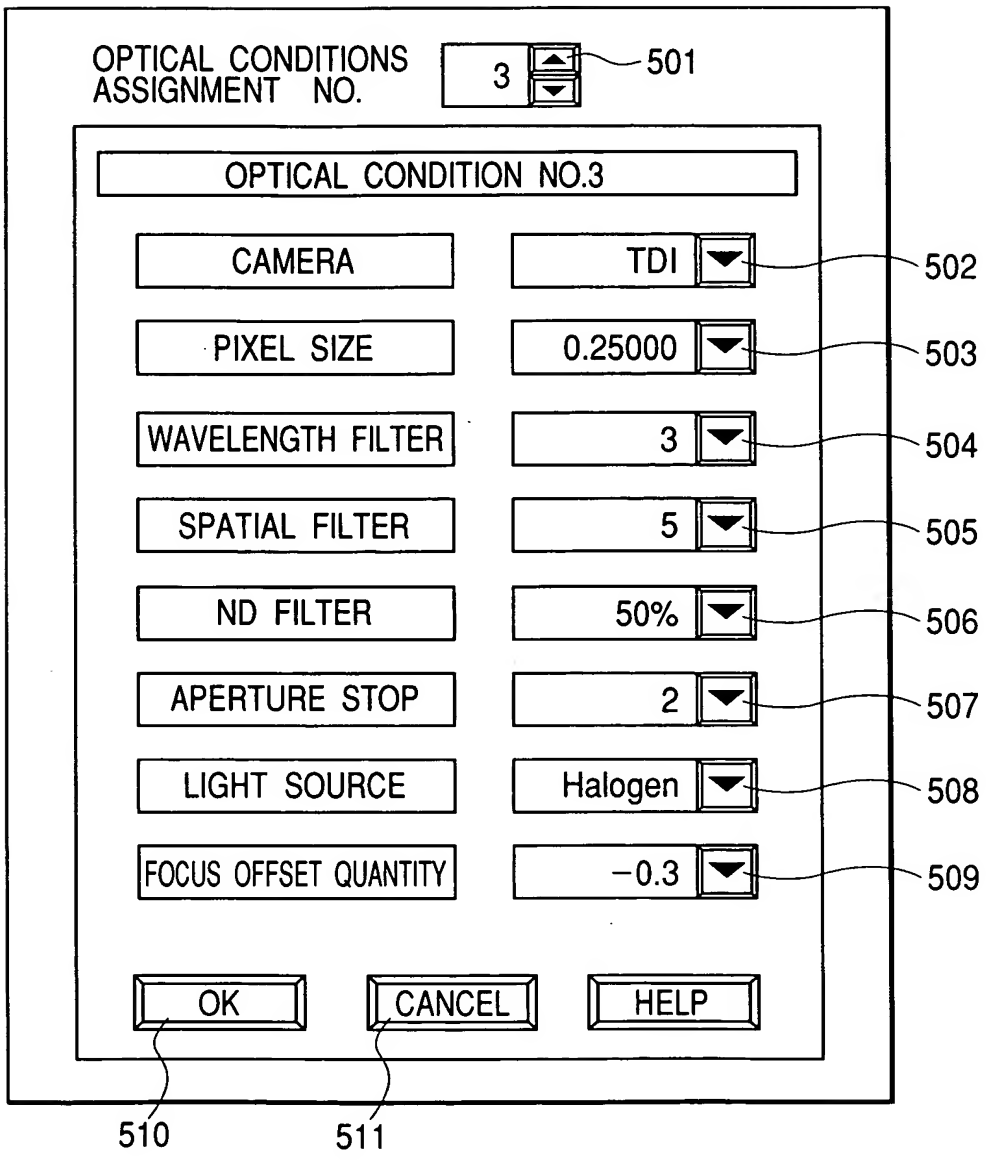

OPTICAL CONDITIONS ASSIGNMENT NO.
3
501
OPTICAL CONDITION NO.3
CAMERA
TDI
502
PIXEL SIZE
0.25000
503
WAVELENGTH FILTER
3
504
SPATIAL FILTER
5
505
ND FILTER
50%
506
APERTURE STOP
2
507
LIGHT SOURCE
Halogen
508
FOCUS OFFSET QUANTITY
−0.3
509
OK
CANCEL
HELP
510
511

FIG. 6

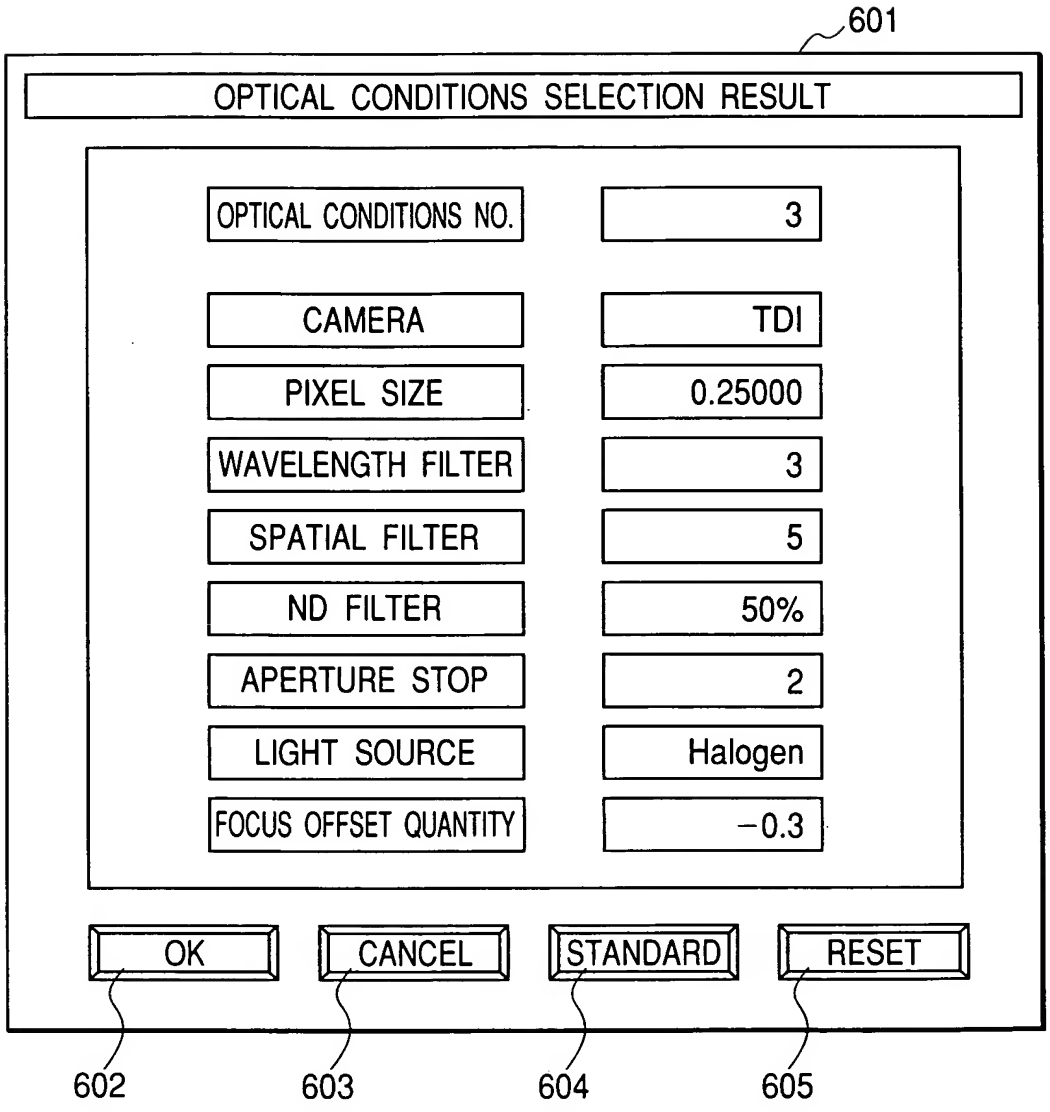

601
OPTICAL CONDITIONS SELECTION RESULT
OPTICAL CONDITIONS NO.
3
CAMERA
TDI
PIXEL SIZE
0.25000
WAVELENGTH FILTER
3
SPATIAL FILTER
5
ND FILTER
50%
APERTURE STOP
2
LIGHT SOURCE
Halogen
FOCUS OFFSET QUANTITY
−0.3
OK
CANCEL
STANDARD
RESET
602
603
604
605

FIG. 7

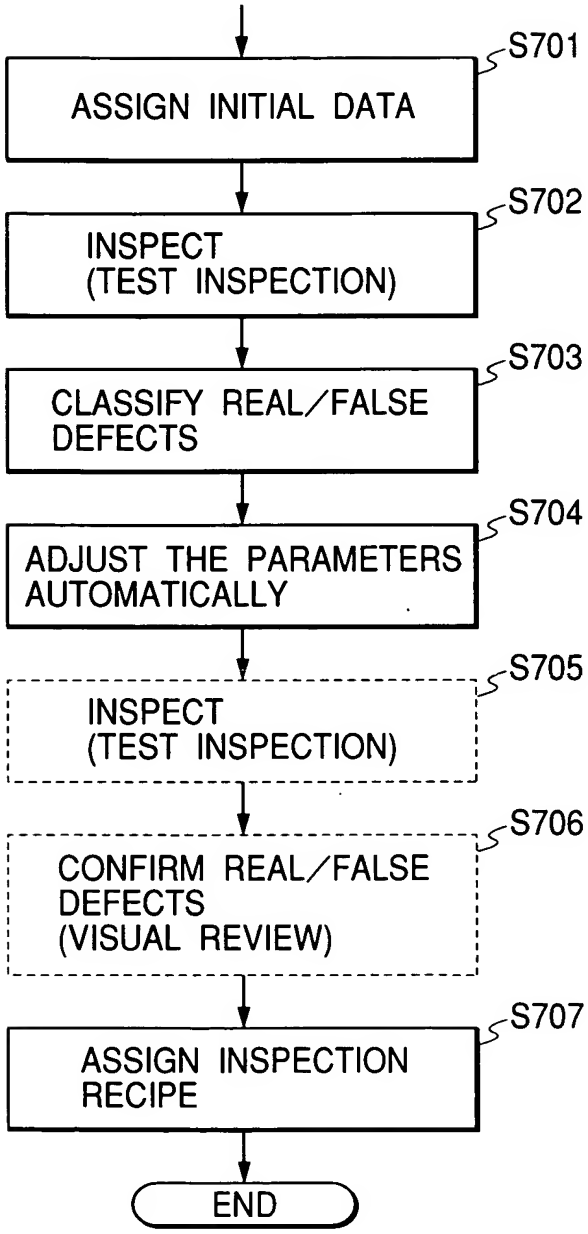

S701
ASSIGN INITIAL DATA
S702
INSPECT
(TEST INSPECTION)
S703
CLASSIFY REAL/FALSE
DEFECTS
S704
ADJUST THE PARAMETERS
AUTOMATICALLY
S705
INSPECT
(TEST INSPECTION)
S706
CONFIRM REAL/FALSE
DEFECTS
(VISUAL REVIEW)
S707
ASSIGN INSPECTION
RECIPE
END

FIG. 8A

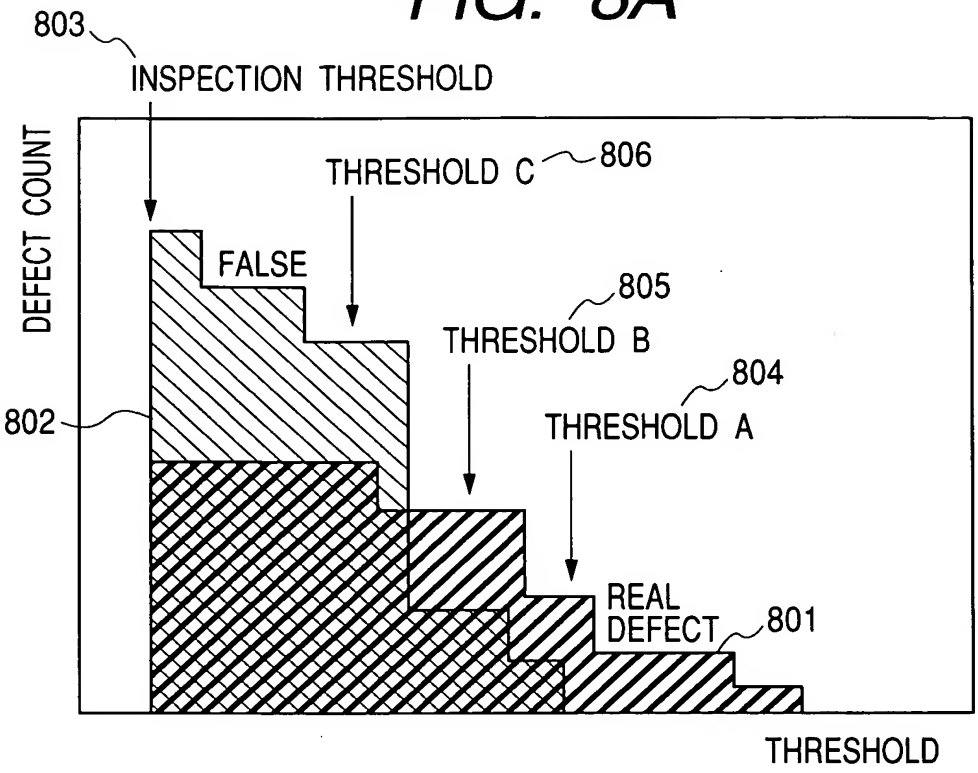

803
INSPECTION THRESHOLD
DEFECT COUNT
THRESHOLD C
806
FALSE
805
THRESHOLD B
804
THRESHOLD A
802
REAL
DEFECT
801
THRESHOLD

FIG. 8B

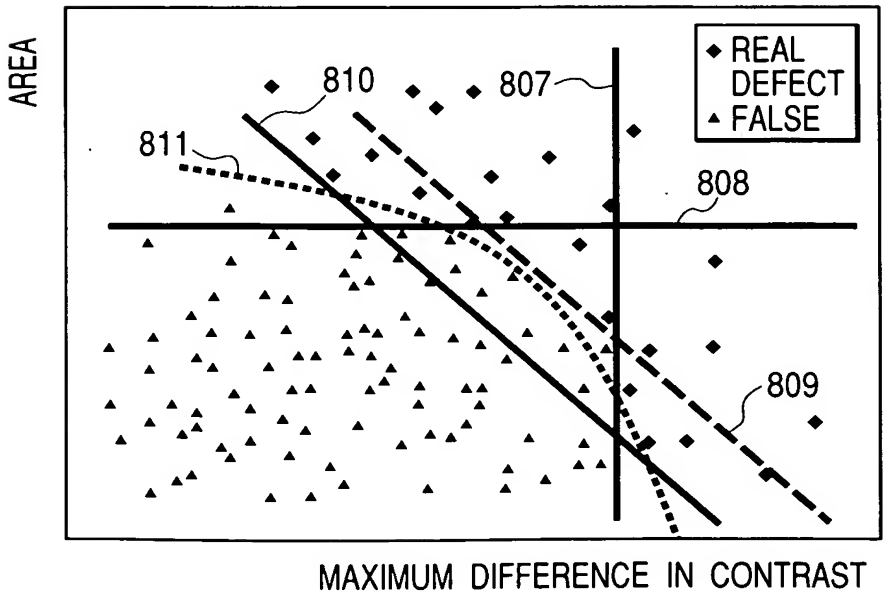

AREA
REAL
DEFECT
FALSE
810
807
811
808
809
MAXIMUM DIFFERENCE IN CONTRAST

FIG. 9

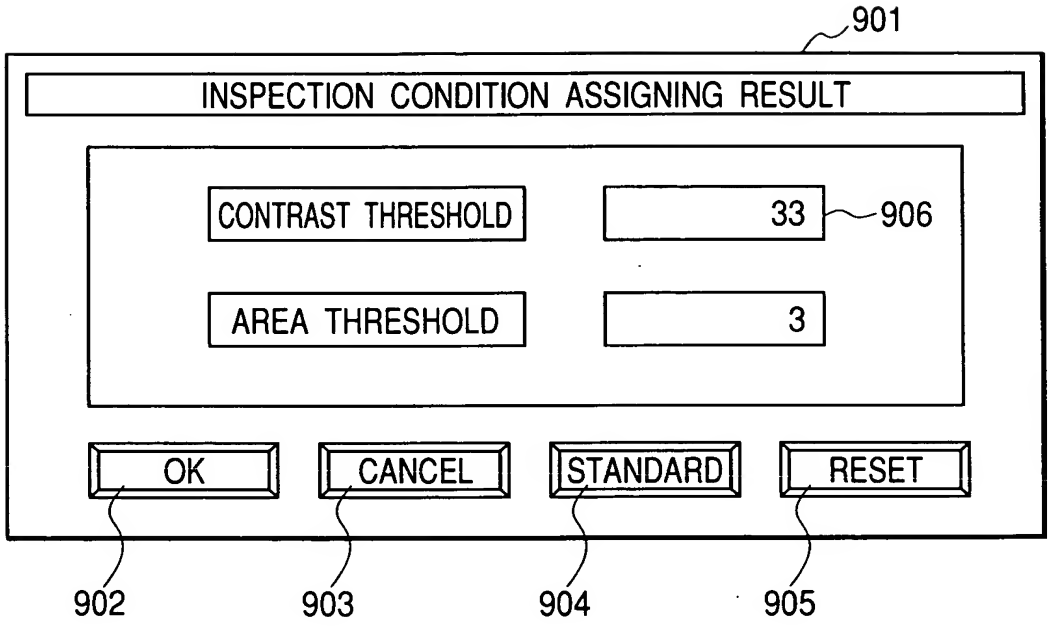

901
INSPECTION CONDITION ASSIGNING RESULT
CONTRAST THRESHOLD
33
906
AREA THRESHOLD
3
OK
CANCEL
STANDARD
RESET
902
903
904
905

FIG. 10

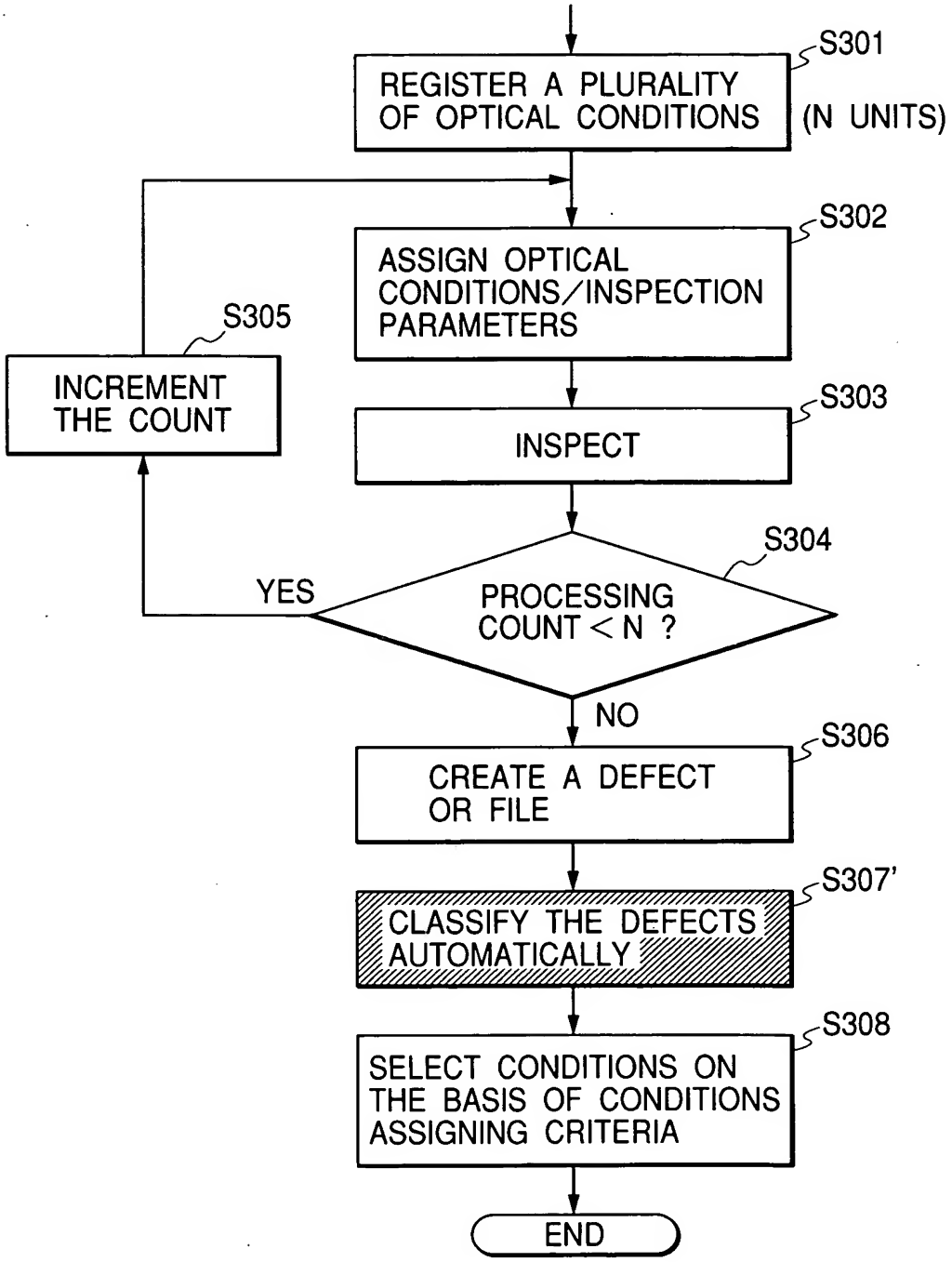
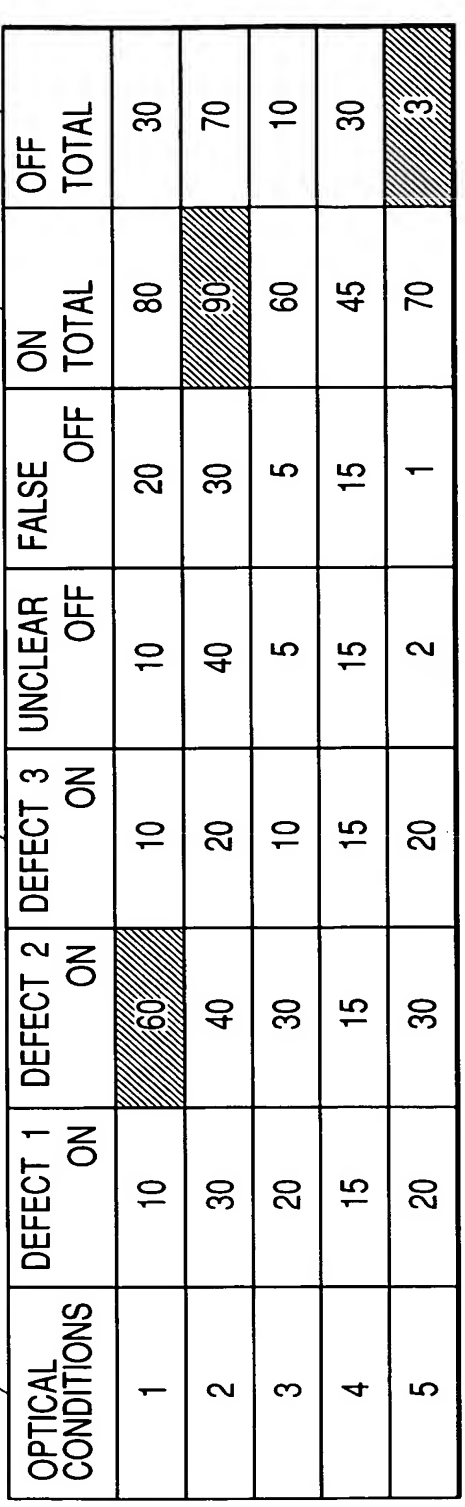

S301
REGISTER A PLURALITY OF OPTICAL CONDITIONS
(N UNITS)
S302
ASSIGN OPTICAL CONDITIONS/INSPECTION PARAMETERS
S303
INSPECT
S304
PROCESSING COUNT < N ?
YES
S305
INCREMENT THE COUNT
NO
S306
CREATE A DEFECT OR FILE
S307'
CLASSIFY THE DEFECTS AUTOMATICALLY
S308
SELECT CONDITIONS ON THE BASIS OF CONDITIONS ASSIGNING CRITERIA
END

FIG. 11



OPTICAL CONDITIONS (1101)	DEFECT 1 ON	DEFECT 2 ON	DEFECT 3 ON (1102)	UNCLEAR OFF	FALSE OFF	ON TOTAL (1103)	OFF TOTAL (1104)
1	10	60	10	10	20	80	30
2	30	40	20	40	30	90	70
3	20	30	10	5	5	60	10
4	15	15	15	15	15	45	30
5	20	30	20	2	1	70	3

FIG. 12

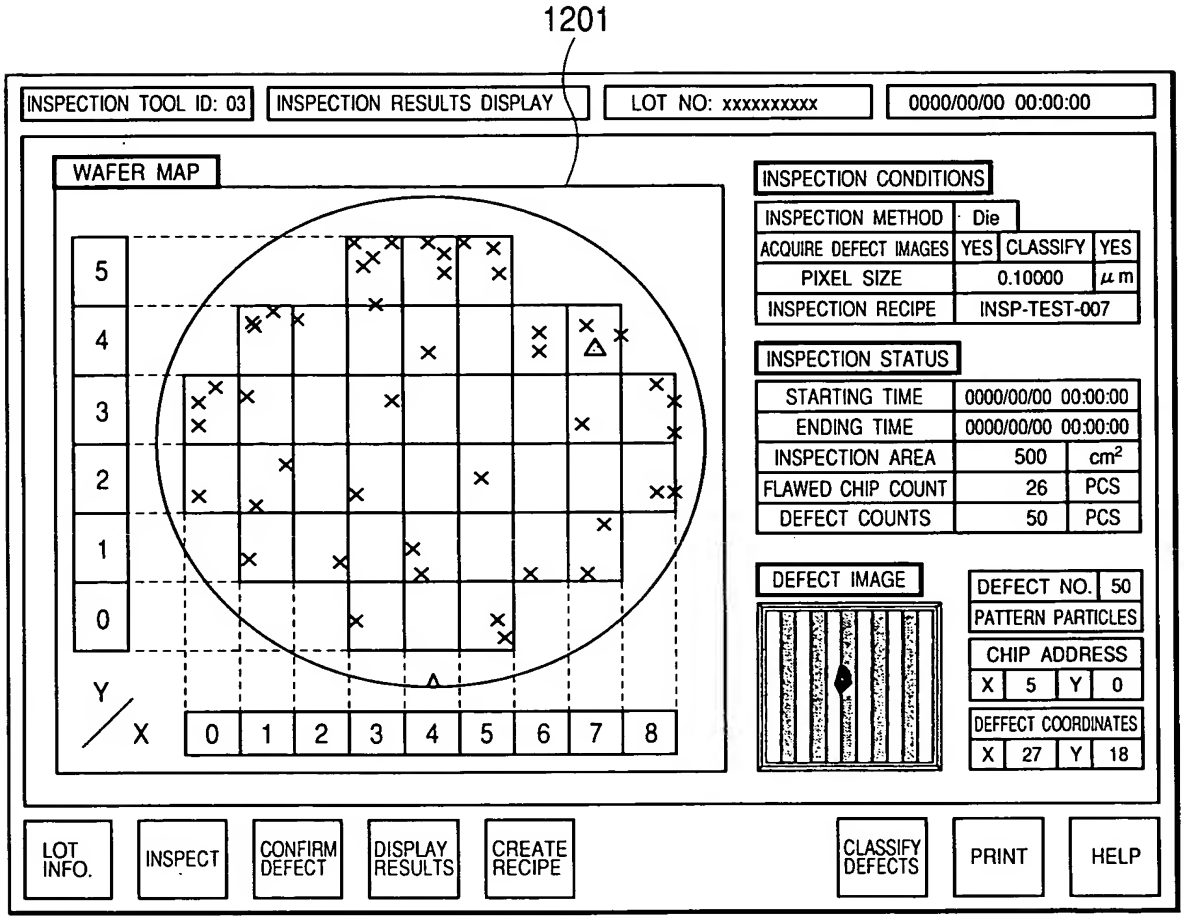

1201
INSPECTION TOOL ID: 03
INSPECTION RESULTS DISPLAY
LOT NO: xxxxxxxxxx
0000/00/00 00:00:00
WAFER MAP
INSPECTION CONDITIONS
INSPECTION METHOD
Die
ACQUIRE DEFECT IMAGES
YES
CLASSIFY
YES
PIXEL SIZE
0.10000
μm
INSPECTION RECIPE
INSP-TEST-007
INSPECTION STATUS
STARTING TIME
0000/00/00 00:00:00
ENDING TIME
0000/00/00 00:00:00
INSPECTION AREA
500
cm²
FLAWED CHIP COUNT
26
PCS
DEFECT COUNTS
50
PCS
DEFECT IMAGE
DEFECT NO.
50
PATTERN PARTICLES
CHIP ADDRESS
X
5
Y
0
DEFFECT COORDINATES
X
27
Y
18
Y
X
LOT INFO.
INSPECT
CONFIRM DEFECT
DISPLAY RESULTS
CREATE RECIPE
CLASSIFY DEFECTS
PRINT
HELP

FIG. 13

CATEGORY	NAME (1301)	RESULT DISPLAY ON/OFF (1302)
1	PARTICLE	ON
2	SHORT	ON
3	SCRATCH	ON
4	GRAIN	OFF
5	COLOR VARIATIONS	OFF
6	OTHERS	OFF
7	UNCLEAR	OFF

FIG. 14

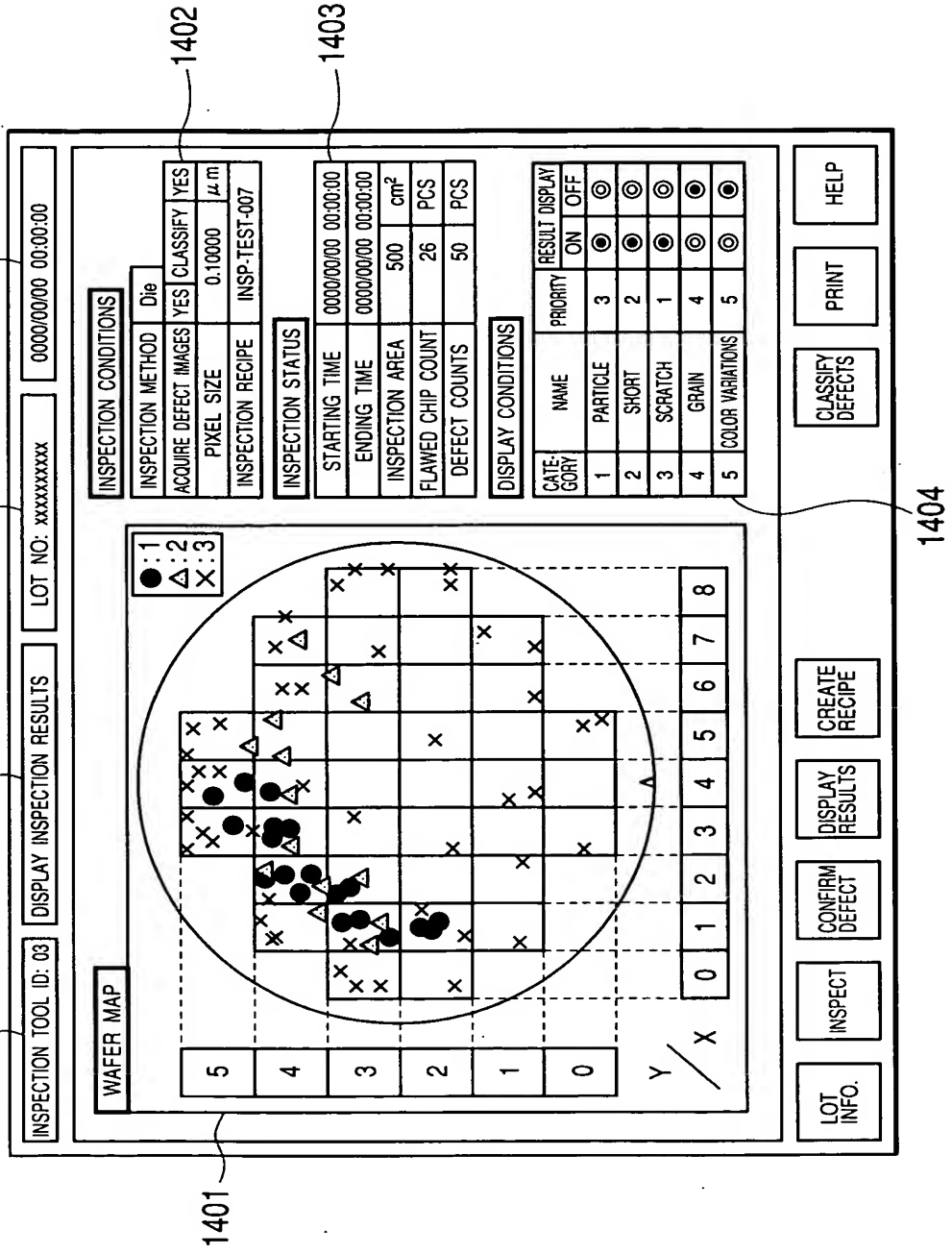

1401
1402
1403
1404
1405
1406
1407
1408
INSPECTION TOOL ID: 03
DISPLAY INSPECTION RESULTS
LOT NO: xxxxxxxxxx
0000/00/00 00:00:00
WAFER MAP
●:1
△:2
×:3
INSPECTION CONDITIONS
INSPECTION METHOD Die
ACQUIRE DEFECT IMAGES YES
CLASSIFY YES
PIXEL SIZE 0.10000 μm
INSPECTION RECIPE INSP-TEST-007
INSPECTION STATUS
STARTING TIME 0000/00/00 00:00:00
ENDING TIME 0000/00/00 00:00:00
INSPECTION AREA 500 cm²
FLAWED CHIP COUNT 26 PCS
DEFECT COUNTS 50 PCS
DISPLAY CONDITIONS
CATEGORY NAME PRIORITY RESULT DISPLAY ON OFF
1 PARTICLE 3
2 SHORT 2
3 SCRATCH 1
4 GRAIN 4
5 COLOR VARIATIONS 5
Y
X
LOT INFO.
INSPECT
CONFIRM DEFECT
DISPLAY RESULTS
CREATE RECIPE
CLASSIFY DEFECTS
PRINT
HELP

FIG. 15

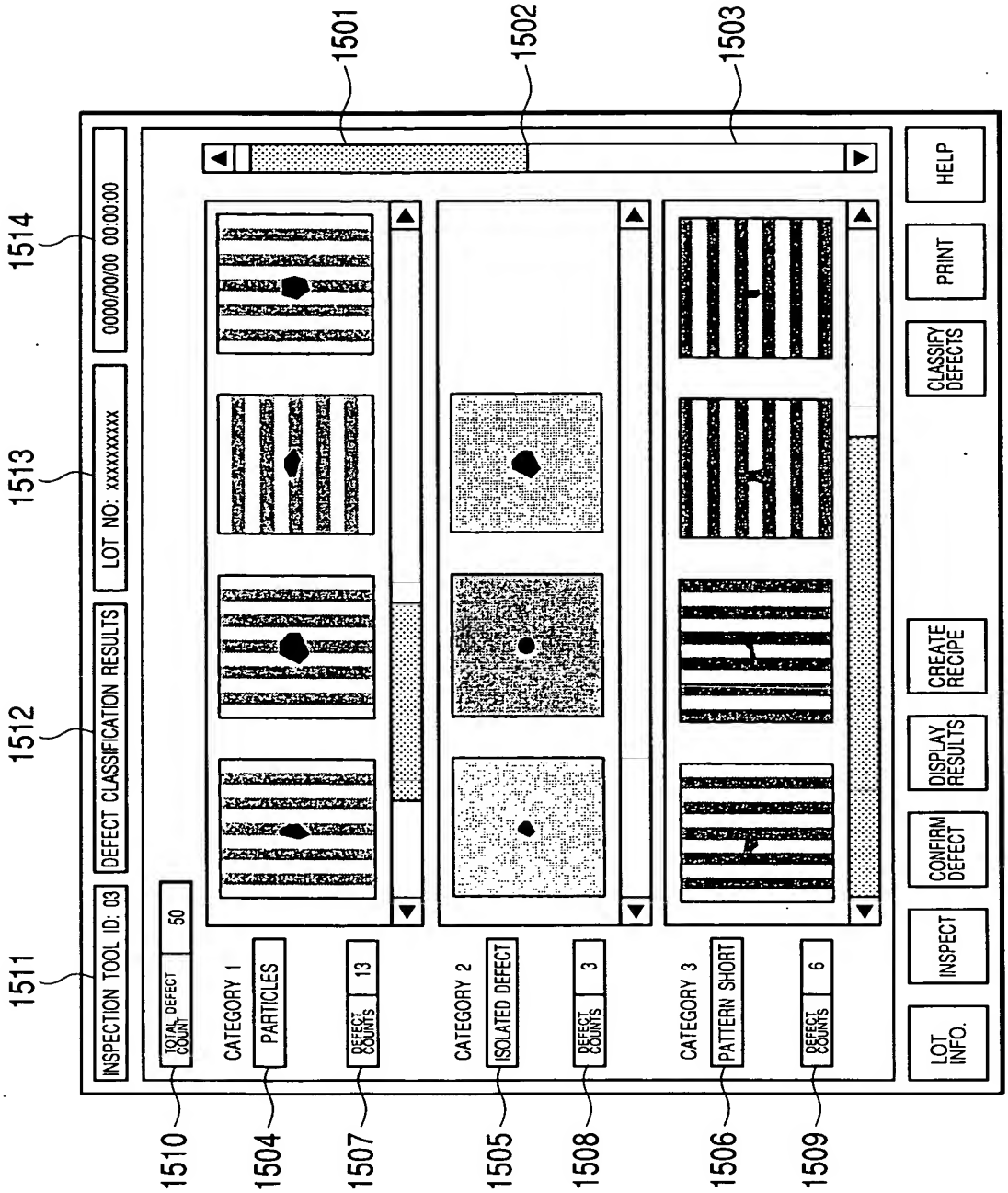

1501
1502
1503
1514
1513
1512
1511
INSPECTION TOOL ID: 03
DEFECT CLASSIFICATION RESULTS
LOT NO: XXXXXXXXX
0000/00/00 00:00:00
HELP
PRINT
CLASSIFY DEFECTS
CREATE RECIPE
DISPLAY RESULTS
CONFIRM DEFECT
INSPECT
LOT INFO.
TOTAL DEFECT COUNT
50
CATEGORY 1
PARTICLES
DEFECT COUNTS
13
CATEGORY 2
ISOLATED DEFECT
DEFECT COUNTS
3
CATEGORY 3
PATTERN SHORT
DEFECT COUNTS
6
1510
1504
1507
1505
1508
1506
1509

FIG. 16

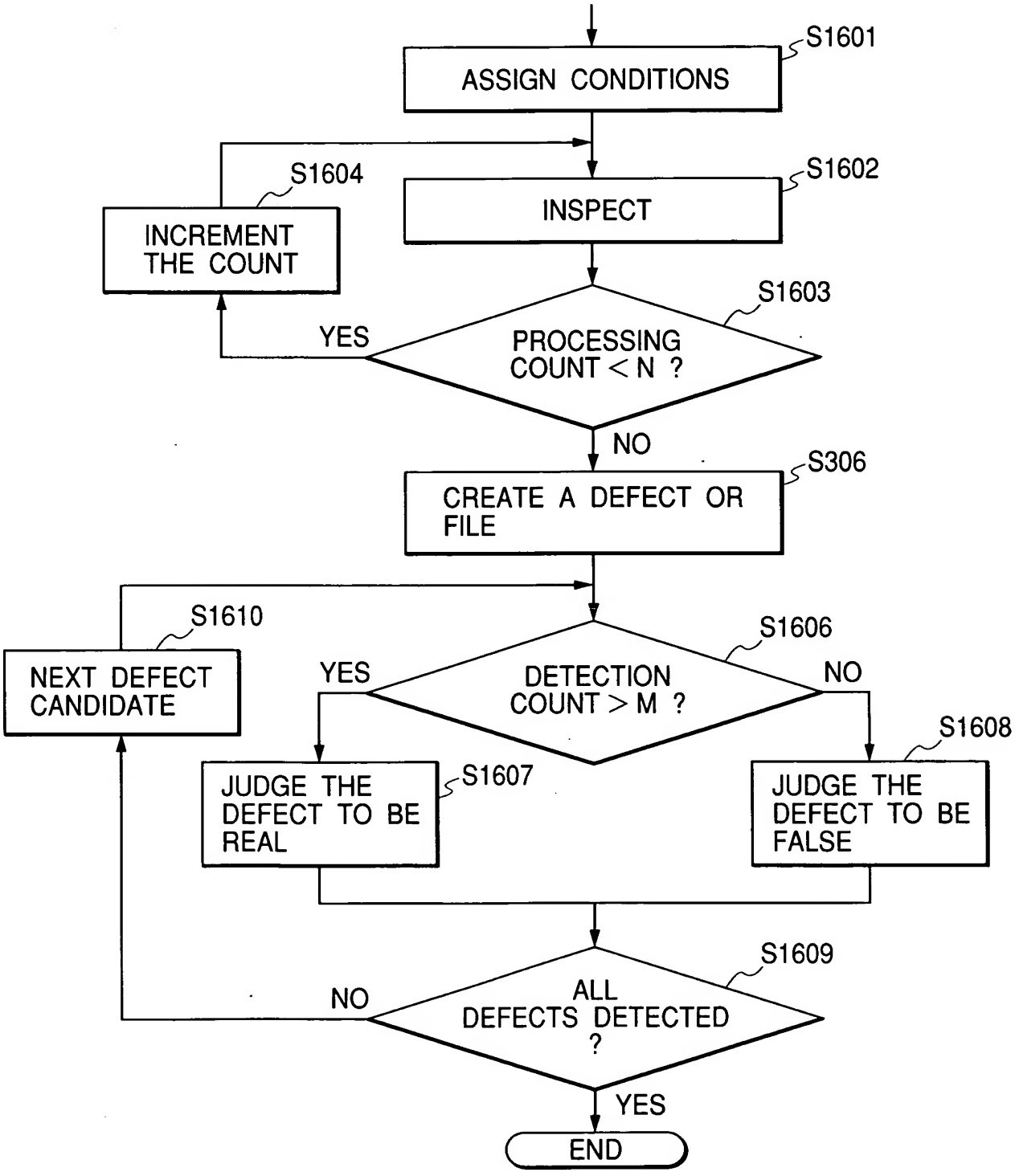

S1601
ASSIGN CONDITIONS
S1602
INSPECT
S1603
PROCESSING COUNT < N ?
YES
S1604
INCREMENT THE COUNT
NO
S306
CREATE A DEFECT OR FILE
S1606
DETECTION COUNT > M ?
YES
NO
S1607
JUDGE THE DEFECT TO BE REAL
S1608
JUDGE THE DEFECT TO BE FALSE
S1609
ALL DEFECTS DETECTED ?
NO
YES
S1610
NEXT DEFECT CANDIDATE
END

FIG. 17

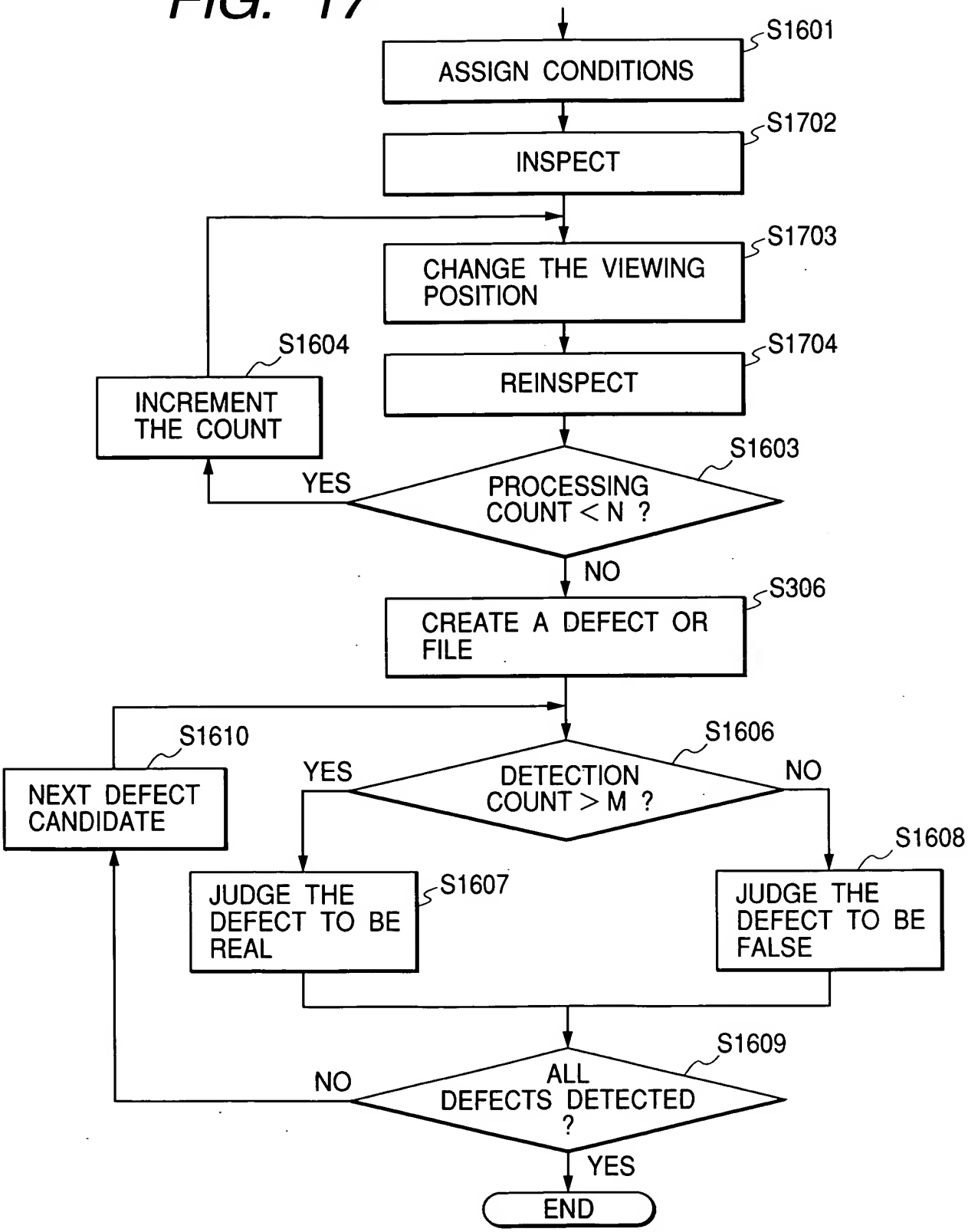

S1601
ASSIGN CONDITIONS
S1702
INSPECT
S1703
CHANGE THE VIEWING POSITION
S1704
REINSPECT
S1603
PROCESSING COUNT < N ?
YES
S1604
INCREMENT THE COUNT
NO
S306
CREATE A DEFECT OR FILE
S1606
DETECTION COUNT > M ?
YES
NO
S1610
NEXT DEFECT CANDIDATE
S1607
JUDGE THE DEFECT TO BE REAL
S1608
JUDGE THE DEFECT TO BE FALSE
S1609
ALL DEFECTS DETECTED ?
NO
YES
END

FIG. 18

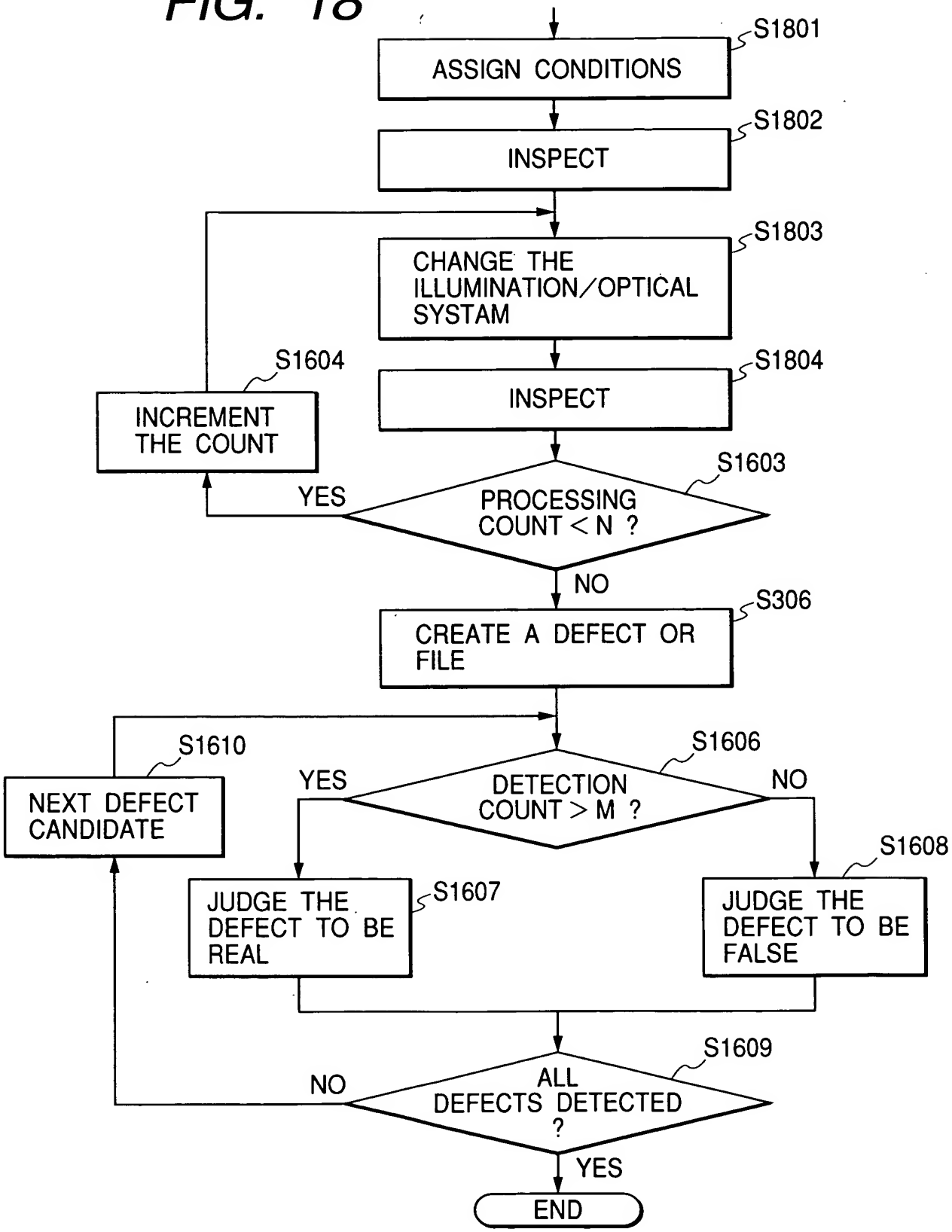

ASSIGN CONDITIONS
S1801
INSPECT
S1802
CHANGE THE ILLUMINATION/OPTICAL SYSTAM
S1803
INSPECT
S1804
PROCESSING COUNT < N ?
S1603
YES
INCREMENT THE COUNT
S1604
NO
CREATE A DEFECT OR FILE
S306
DETECTION COUNT > M ?
S1606
YES
NO
NEXT DEFECT CANDIDATE
S1610
JUDGE THE DEFECT TO BE REAL
S1607
JUDGE THE DEFECT TO BE FALSE
S1608
ALL DEFECTS DETECTED ?
S1609
NO
YES
END

FIG. 19

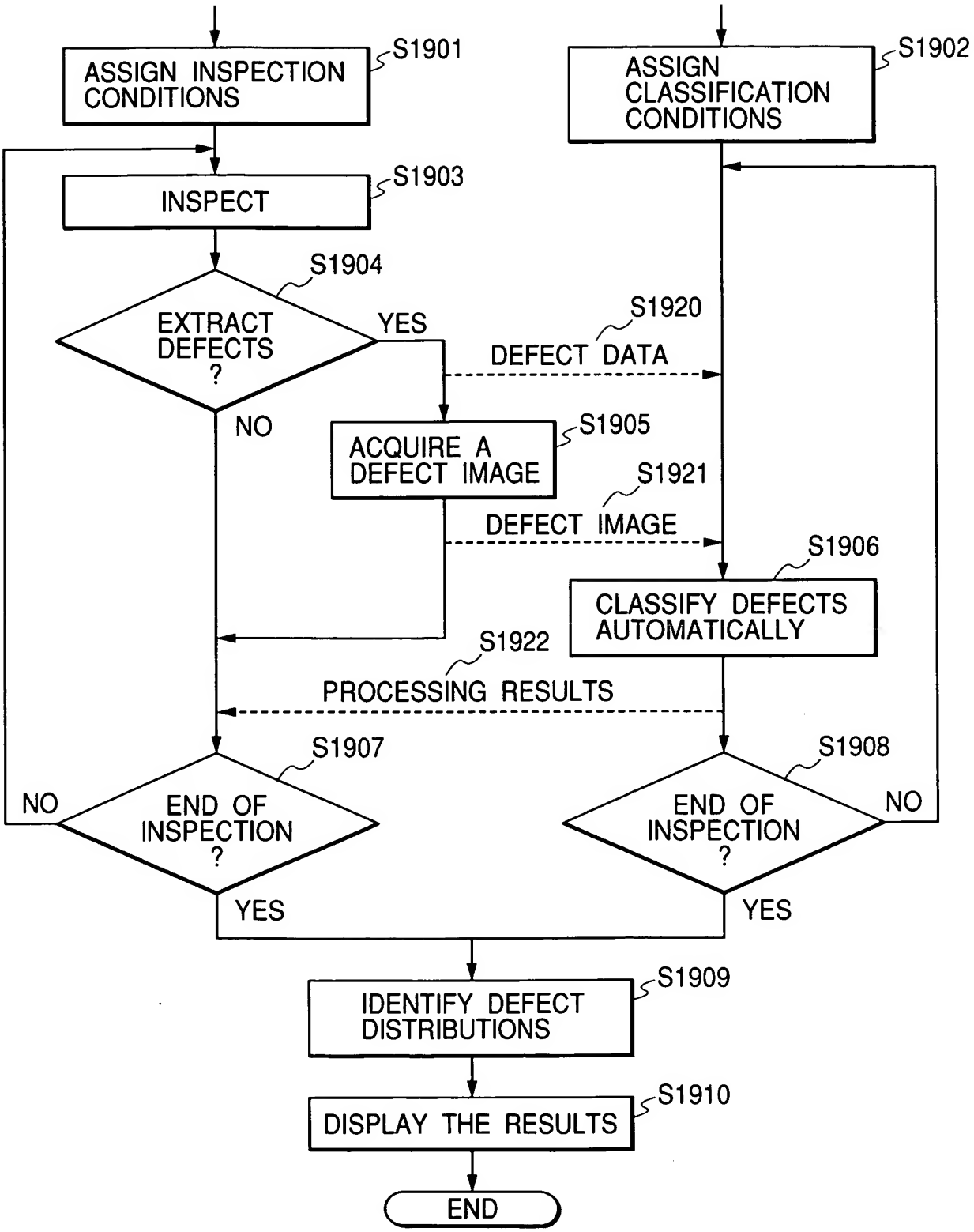
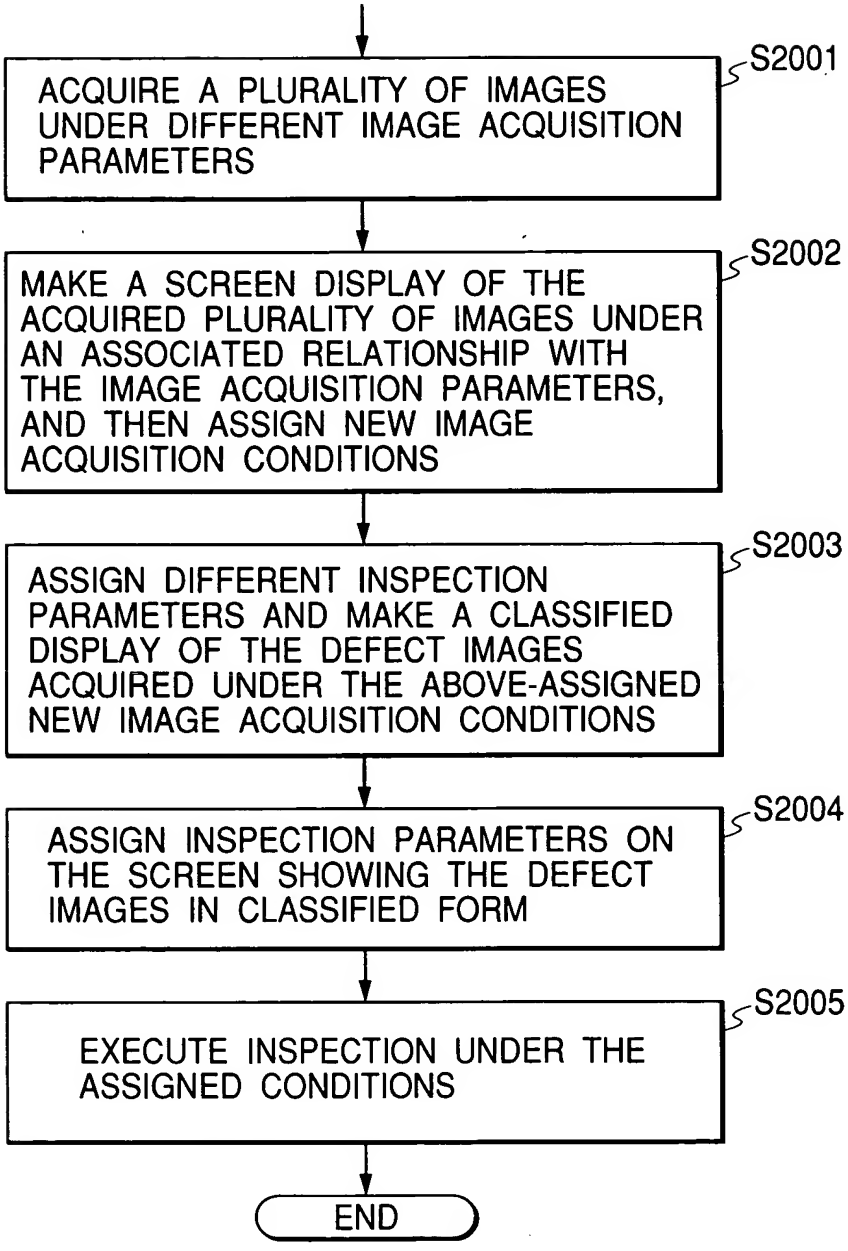

ASSIGN INSPECTION CONDITIONS
S1901
ASSIGN CLASSIFICATION CONDITIONS
S1902
INSPECT
S1903
EXTRACT DEFECTS ?
S1904
YES
NO
S1920
DEFECT DATA
ACQUIRE A DEFECT IMAGE
S1905
S1921
DEFECT IMAGE
S1906
CLASSIFY DEFECTS AUTOMATICALLY
S1922
PROCESSING RESULTS
END OF INSPECTION ?
S1907
NO
YES
END OF INSPECTION ?
S1908
NO
YES
IDENTIFY DEFECT DISTRIBUTIONS
S1909
DISPLAY THE RESULTS
S1910
END

FIG. 20


ACQUIRE A PLURALITY OF IMAGES UNDER DIFFERENT IMAGE ACQUISITION PARAMETERS
S2001
MAKE A SCREEN DISPLAY OF THE ACQUIRED PLURALITY OF IMAGES UNDER AN ASSOCIATED RELATIONSHIP WITH THE IMAGE ACQUISITION PARAMETERS, AND THEN ASSIGN NEW IMAGE ACQUISITION CONDITIONS
S2002
ASSIGN DIFFERENT INSPECTION PARAMETERS AND MAKE A CLASSIFIED DISPLAY OF THE DEFECT IMAGES ACQUIRED UNDER THE ABOVE-ASSIGNED NEW IMAGE ACQUISITION CONDITIONS
S2003
ASSIGN INSPECTION PARAMETERS ON THE SCREEN SHOWING THE DEFECT IMAGES IN CLASSIFIED FORM
S2004
EXECUTE INSPECTION UNDER THE ASSIGNED CONDITIONS
S2005
END

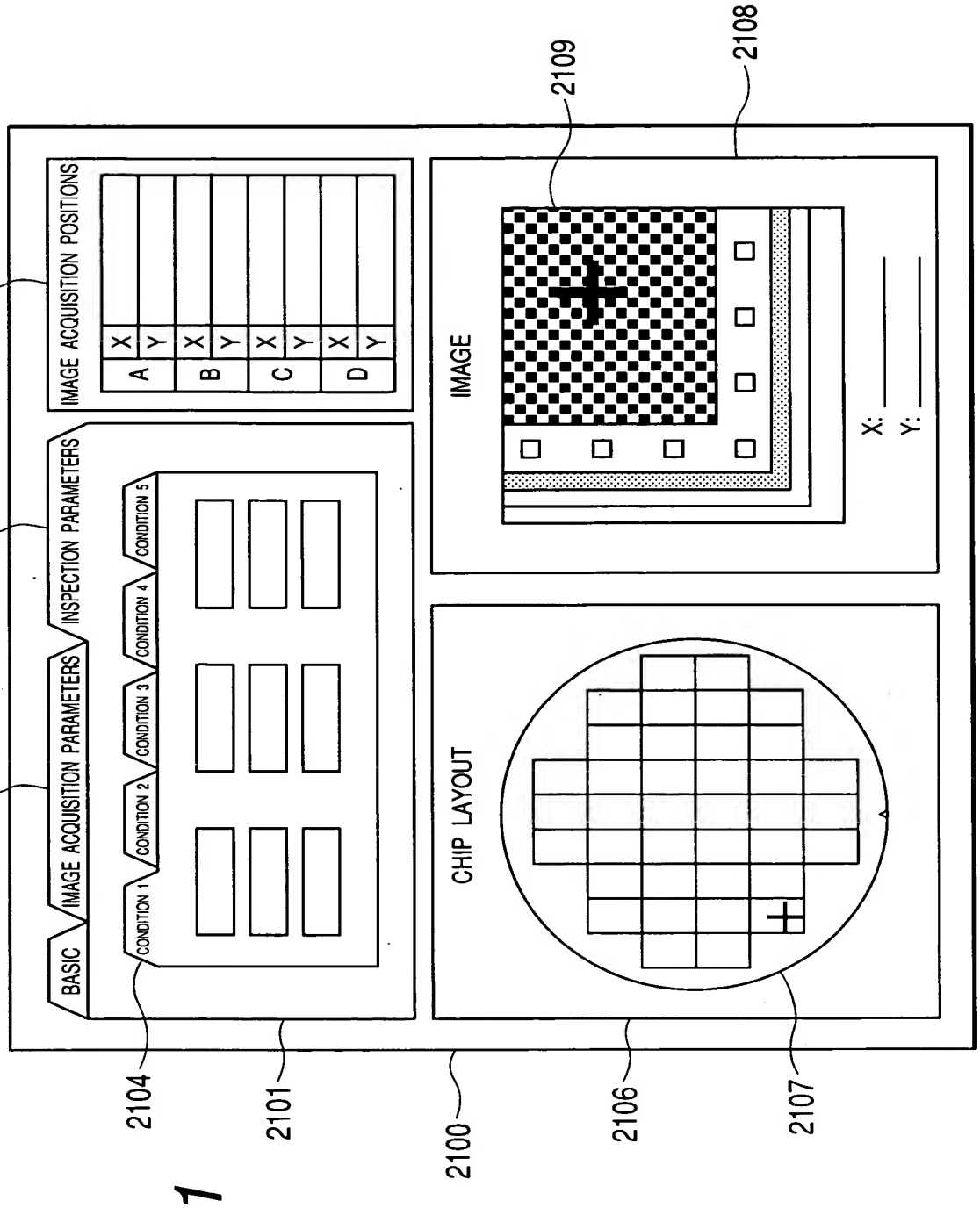

2105
IMAGE ACQUISITION POSITIONS
A X Y
B X Y
C X Y
D X Y
2102
INSPECTION PARAMETERS
2103
IMAGE ACQUISITION PARAMETERS
BASIC
CONDITION 1
CONDITION 2
CONDITION 3
CONDITION 4
CONDITION 5
2104
2101
2109
2108
IMAGE
X:
Y:
CHIP LAYOUT
2100
2106
2107

FIG. 21

FIG. 22

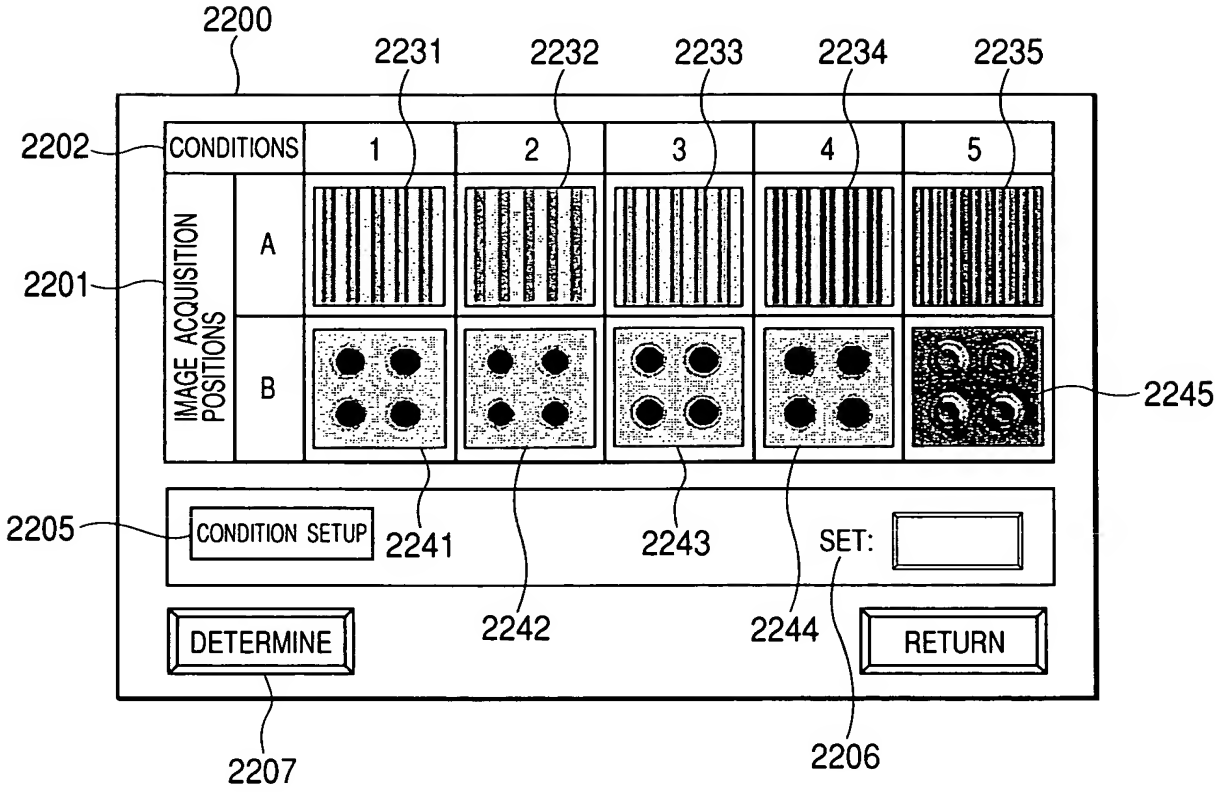

2200
2231
2232
2233
2234
2235
2202
CONDITIONS
1
2
3
4
5
2201
IMAGE ACQUISITION POSITIONS
A
B
2245
2205
CONDITION SETUP
2241
2243
SET:
2242
2244
DETERMINE
RETURN
2207
2206

FIG. 23

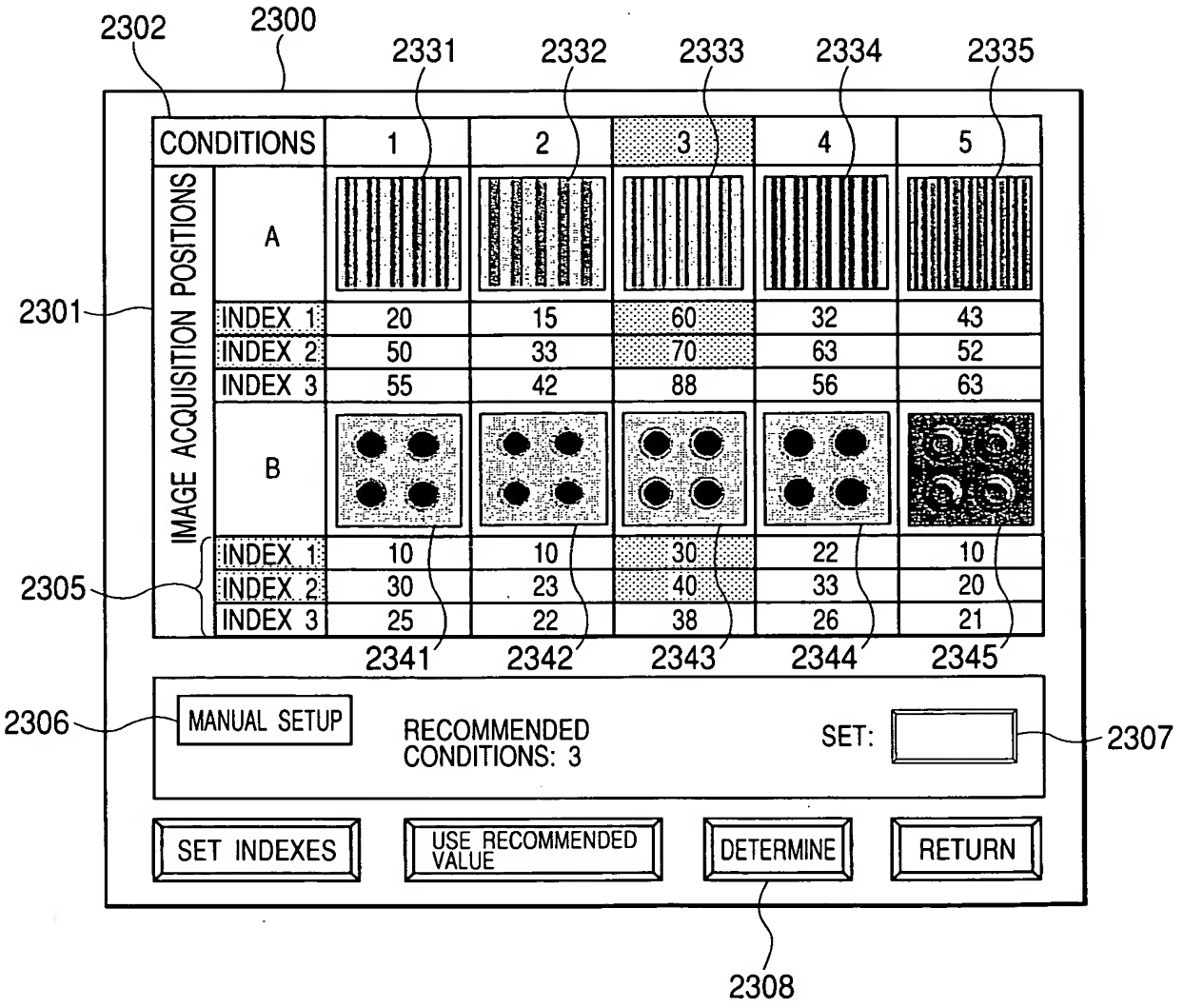

2302
2300
2331
2332
2333
2334
2335
CONDITIONS
1
2
3
4
5
IMAGE ACQUISITION POSITIONS
A
INDEX 1
20
15
60
32
43
INDEX 2
50
33
70
63
52
INDEX 3
55
42
88
56
63
B
INDEX 1
10
10
30
22
10
INDEX 2
30
23
40
33
20
INDEX 3
25
22
38
26
21
2301
2305
2341
2342
2343
2344
2345
2306
MANUAL SETUP
RECOMMENDED CONDITIONS: 3
SET:
2307
SET INDEXES
USE RECOMMENDED VALUE
DETERMINE
RETURN
2308

FIG. 24

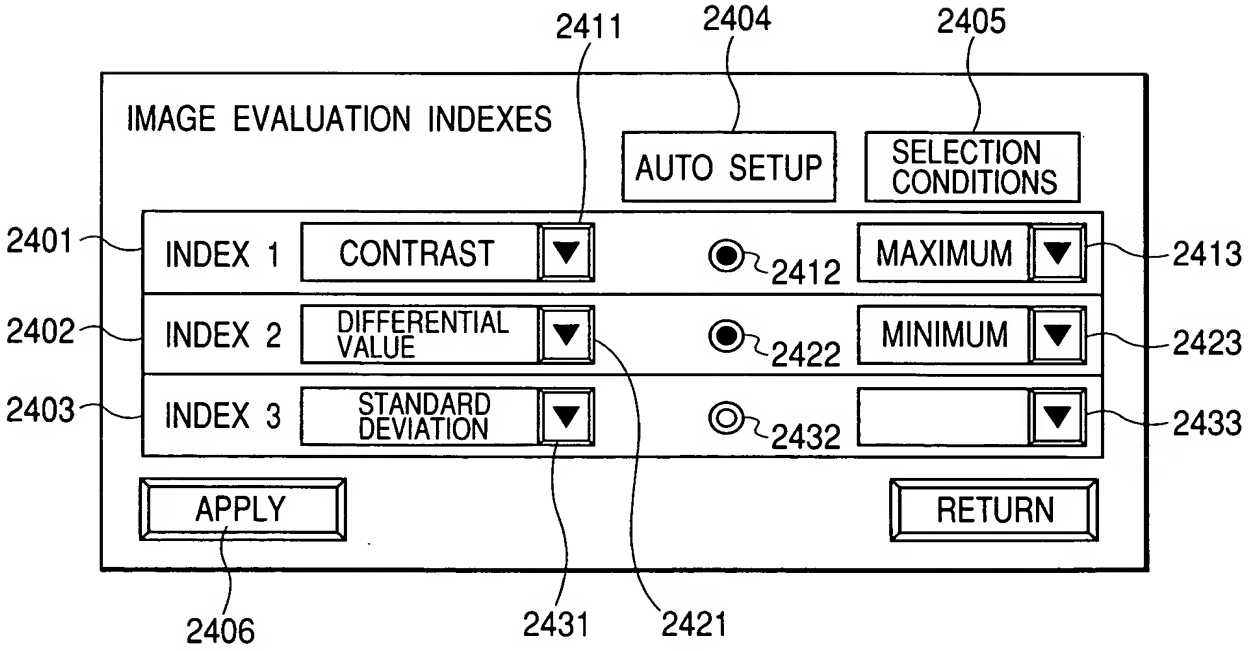

2411
2404
2405
IMAGE EVALUATION INDEXES
AUTO SETUP
SELECTION CONDITIONS
2401
INDEX 1
CONTRAST
2412
MAXIMUM
2413
2402
INDEX 2
DIFFERENTIAL VALUE
2422
MINIMUM
2423
2403
INDEX 3
STANDARD DEVIATION
2432
2433
APPLY
RETURN
2406
2431
2421

FIG. 25

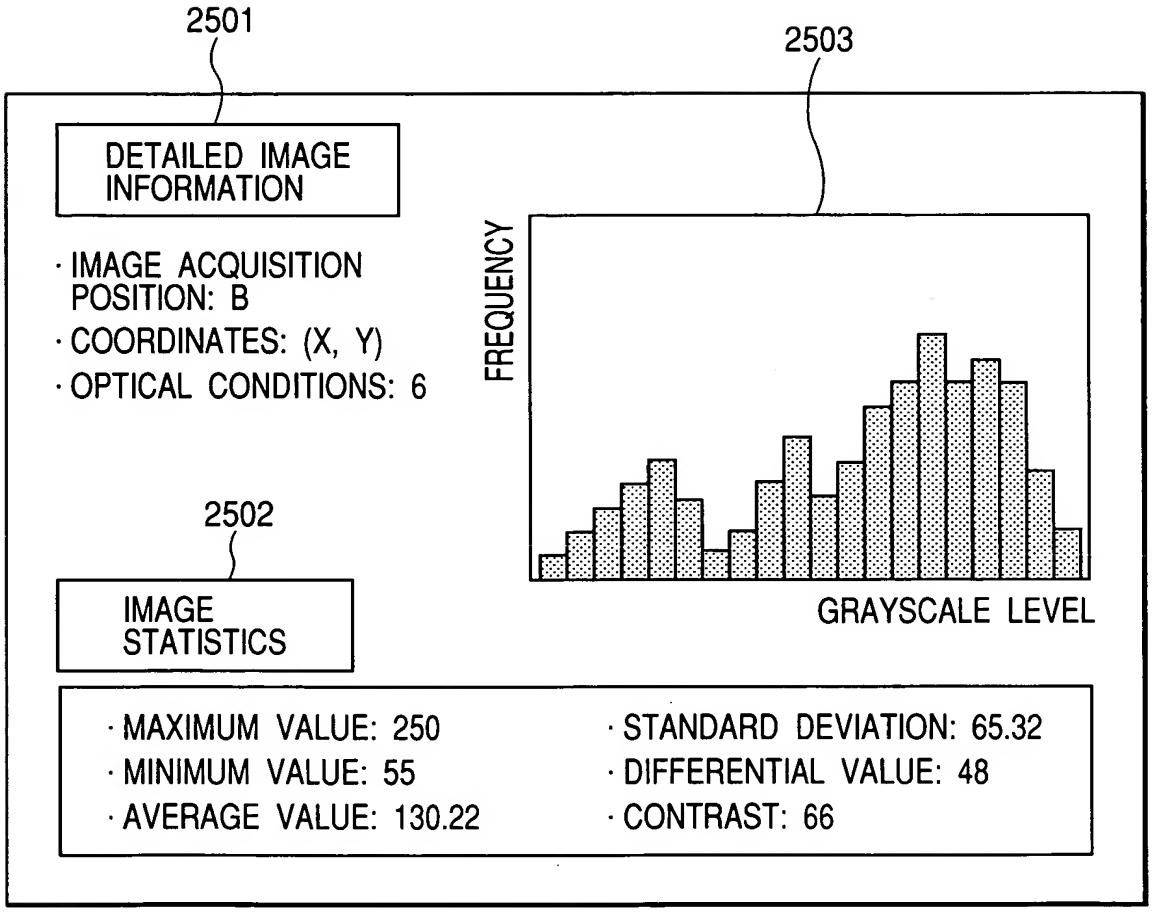

2501
2503
DETAILED IMAGE INFORMATION
· IMAGE ACQUISITION POSITION: B
· COORDINATES: (X, Y)
· OPTICAL CONDITIONS: 6
FREQUENCY
GRAYSCALE LEVEL
2502
IMAGE STATISTICS
· MAXIMUM VALUE: 250
· MINIMUM VALUE: 55
· AVERAGE VALUE: 130.22
· STANDARD DEVIATION: 65.32
· DIFFERENTIAL VALUE: 48
· CONTRAST: 66

FIG. 26

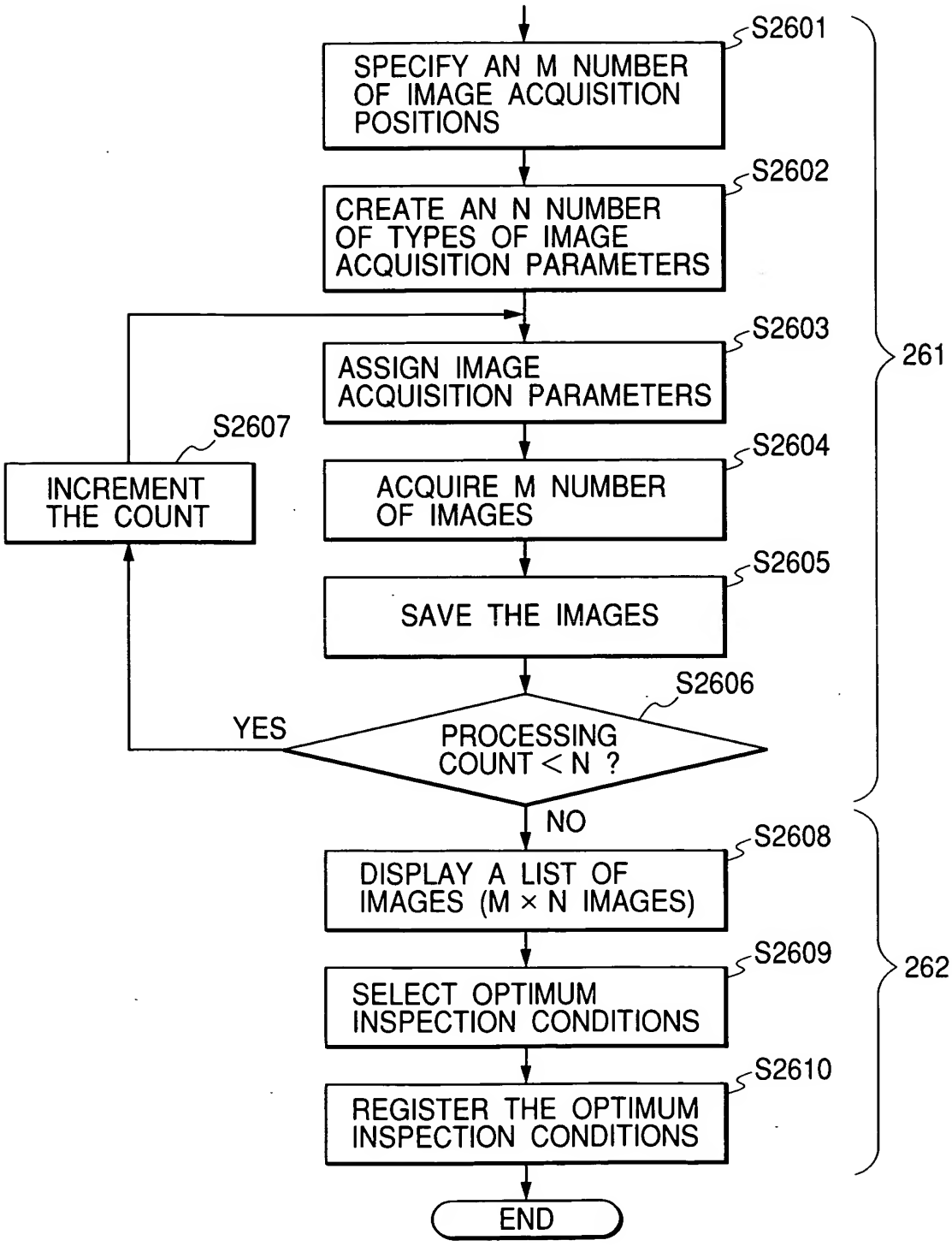

S2601
SPECIFY AN M NUMBER OF IMAGE ACQUISITION POSITIONS
S2602
CREATE AN N NUMBER OF TYPES OF IMAGE ACQUISITION PARAMETERS
S2603
ASSIGN IMAGE ACQUISITION PARAMETERS
S2604
ACQUIRE M NUMBER OF IMAGES
S2605
SAVE THE IMAGES
S2606
PROCESSING COUNT < N ?
YES
S2607
INCREMENT THE COUNT
NO
261
S2608
DISPLAY A LIST OF IMAGES (M × N IMAGES)
S2609
SELECT OPTIMUM INSPECTION CONDITIONS
S2610
REGISTER THE OPTIMUM INSPECTION CONDITIONS
262
END

FIG. 27

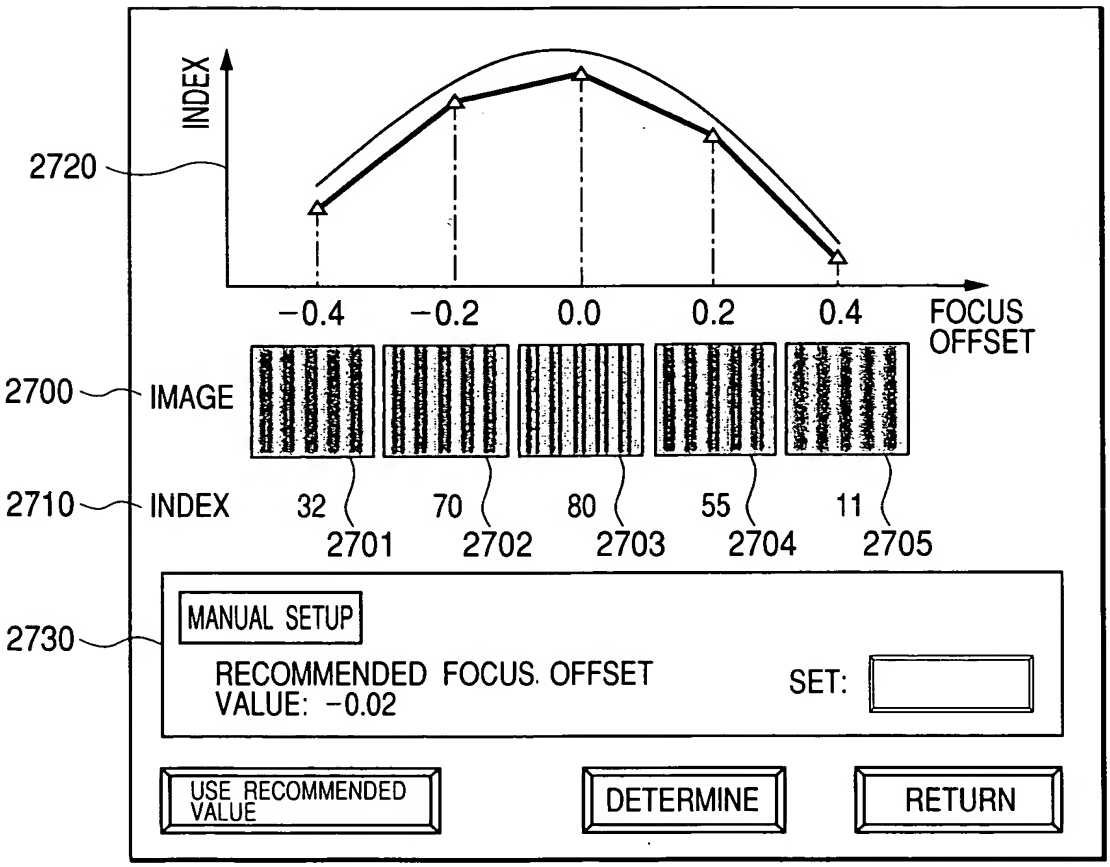

INDEX
2720
−0.4
−0.2
0.0
0.2
0.4
FOCUS OFFSET
2700
IMAGE
2710
INDEX
32
70
80
55
11
2701
2702
2703
2704
2705
2730
MANUAL SETUP
RECOMMENDED FOCUS. OFFSET VALUE: −0.02
SET:
USE RECOMMENDED VALUE
DETERMINE
RETURN

FIG. 28

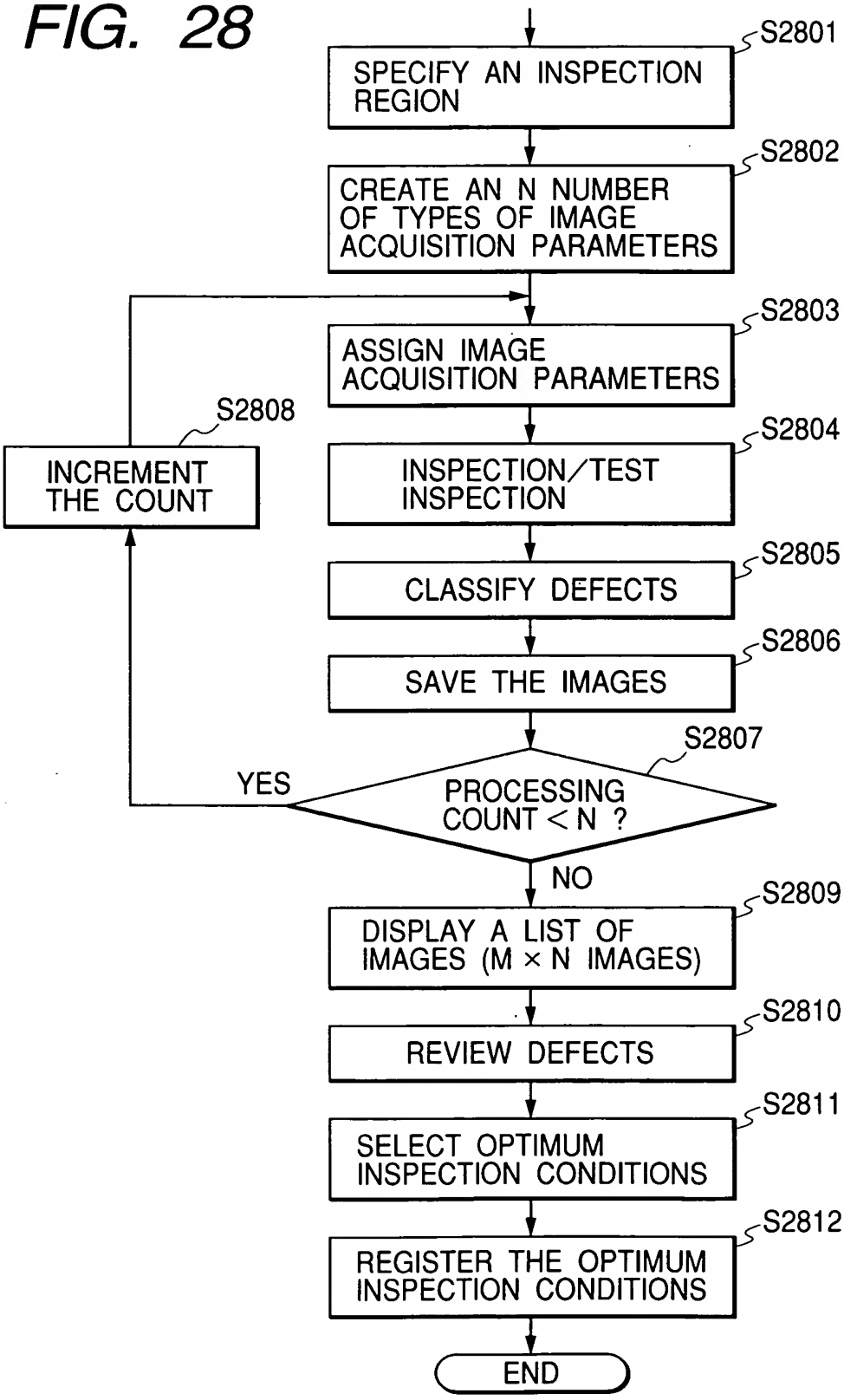

S2801
SPECIFY AN INSPECTION REGION
S2802
CREATE AN N NUMBER OF TYPES OF IMAGE ACQUISITION PARAMETERS
S2803
ASSIGN IMAGE ACQUISITION PARAMETERS
S2804
INSPECTION/TEST INSPECTION
S2805
CLASSIFY DEFECTS
S2806
SAVE THE IMAGES
S2807
PROCESSING COUNT < N ?
YES
S2808
INCREMENT THE COUNT
NO
S2809
DISPLAY A LIST OF IMAGES (M × N IMAGES)
S2810
REVIEW DEFECTS
S2811
SELECT OPTIMUM INSPECTION CONDITIONS
S2812
REGISTER THE OPTIMUM INSPECTION CONDITIONS
END

FIG. 29

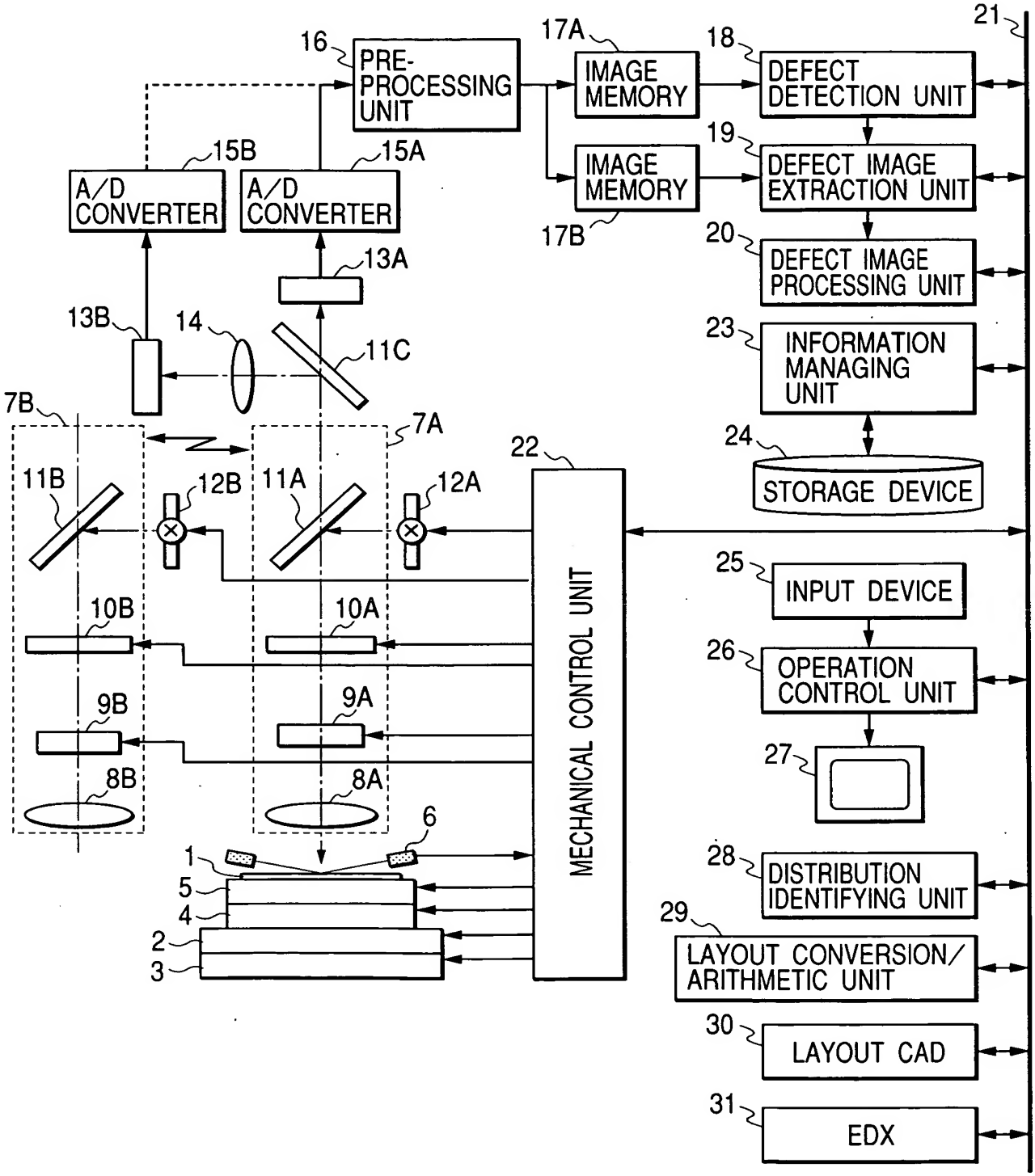

16
PRE-PROCESSING UNIT
17A
IMAGE MEMORY
17B
IMAGE MEMORY
18
DEFECT DETECTION UNIT
19
DEFECT IMAGE EXTRACTION UNIT
20
DEFECT IMAGE PROCESSING UNIT
21
23
INFORMATION MANAGING UNIT
24
STORAGE DEVICE
22
MECHANICAL CONTROL UNIT
25
INPUT DEVICE
26
OPERATION CONTROL UNIT
27
28
DISTRIBUTION IDENTIFYING UNIT
29
LAYOUT CONVERSION/ ARITHMETIC UNIT
30
LAYOUT CAD
31
EDX
15B
A/D CONVERTER
15A
A/D CONVERTER
13A
13B
14
11C
7B
7A
11B
12B
11A
12A
10B
10A
9B
9A
8B
8A
6
1
5
4
2
3

FIG. 30

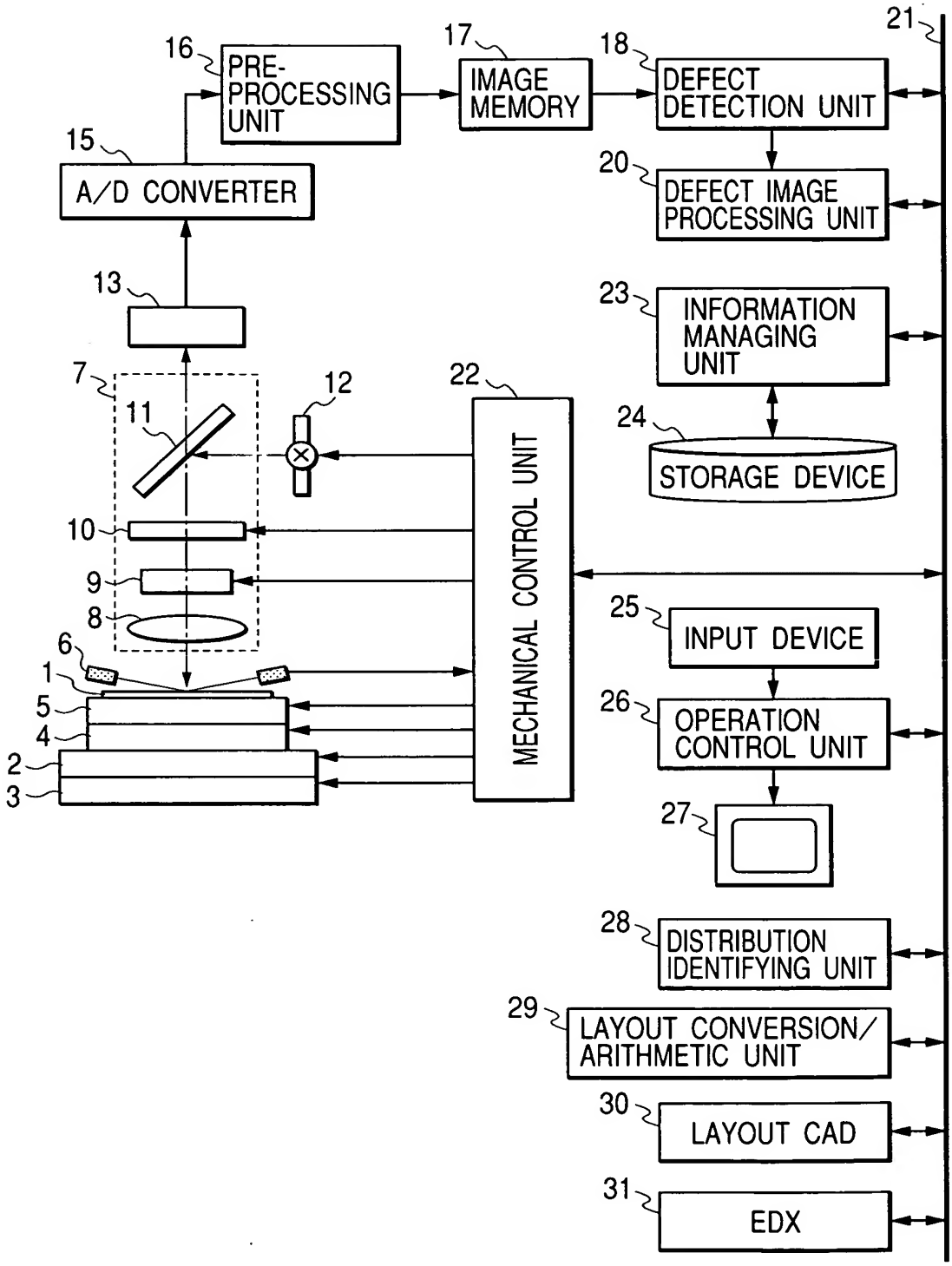
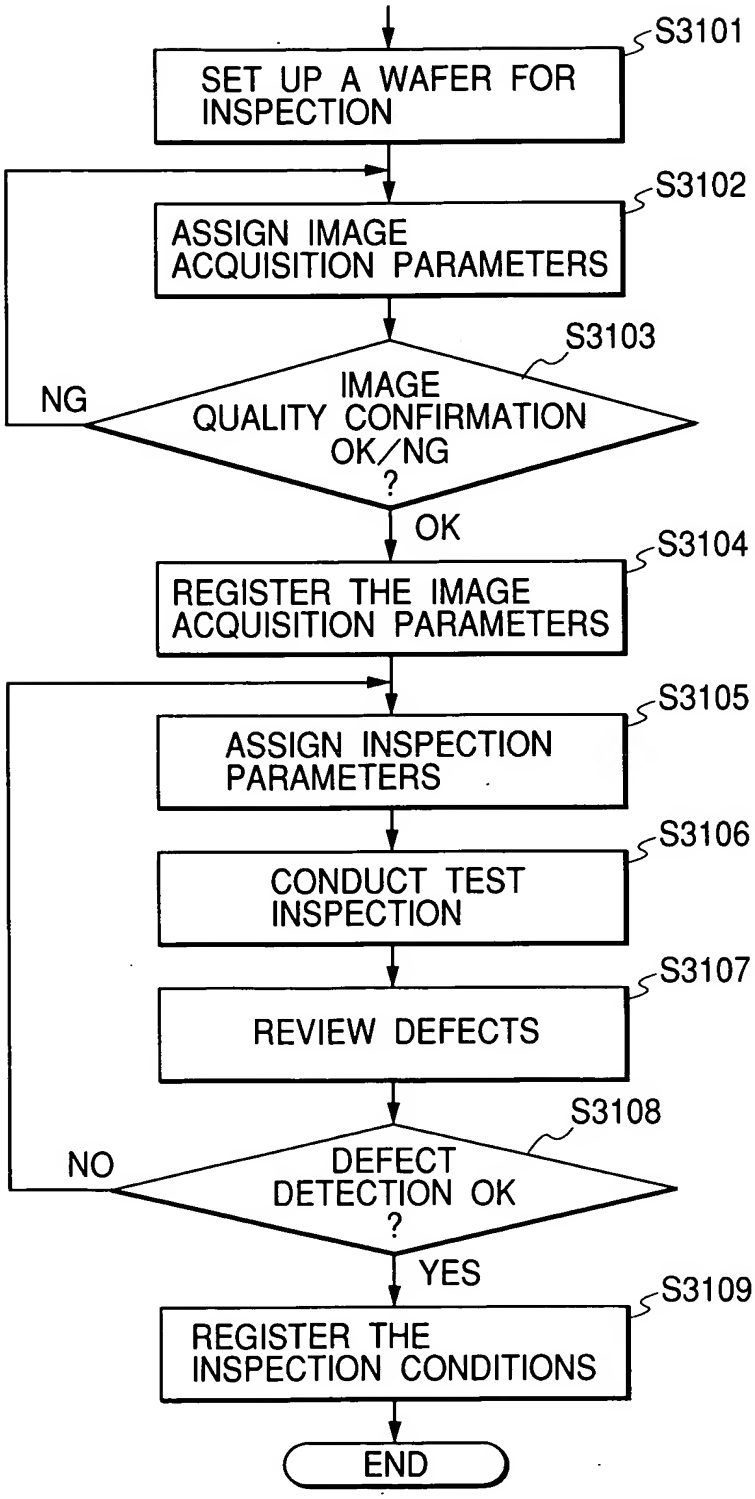

16
PRE-PROCESSING UNIT
17
IMAGE MEMORY
18
DEFECT DETECTION UNIT
21
15
A/D CONVERTER
20
DEFECT IMAGE PROCESSING UNIT
13
23
INFORMATION MANAGING UNIT
7
12
22
11
24
STORAGE DEVICE
10
9
8
MECHANICAL CONTROL UNIT
25
INPUT DEVICE
6
1
26
OPERATION CONTROL UNIT
5
4
27
2
3
28
DISTRIBUTION IDENTIFYING UNIT
29
LAYOUT CONVERSION/ ARITHMETIC UNIT
30
LAYOUT CAD
31
EDX

FIG. 31


S3101
SET UP A WAFER FOR INSPECTION
S3102
ASSIGN IMAGE ACQUISITION PARAMETERS
S3103
IMAGE QUALITY CONFIRMATION OK/NG ?
NG
OK
S3104
REGISTER THE IMAGE ACQUISITION PARAMETERS
S3105
ASSIGN INSPECTION PARAMETERS
S3106
CONDUCT TEST INSPECTION
S3107
REVIEW DEFECTS
S3108
DEFECT DETECTION OK ?
NO
YES
S3109
REGISTER THE INSPECTION CONDITIONS
END